CURRICULUM VITAE

Maria Antoniadou

A. PERSONAL INFORMATION

Father's Name: Yiannakis Antoniades
Date of Birth: 20.08.1981
Marital Status: Married, 2 children
Contact information: Daskalaki 34, 11526, Athens, Greece
Work Address: NCSR "Demokritos", 27 Neapoleos Str, Agia Paraskevi, 15341
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B. EDUCATION

- **2012:** Ph.D., Department of Engineering Sciences, University of Patras, Greece

  Ph.D. Thesis: *«Study of the photoelectrochemical production of hydrogen and electricity by using hybrid organic-inorganic structures»*

- **2007:** Dipl. Ing. in Chemical Engineering, Department of Chemical Engineering, University of Patras, Greece

C. CAREER

2018-Today: **Scientific Director,** Institute of Nanoscience and Nanotechnology, NCSR «Demokritos", Project Funded by HFRI

2014-2018: **Postdoctoral Researcher**, Institute of Nanoscience and Nanotechnology, NCSR «Demokritos" (Supervisor: Dr Polycarpos Falaras)

2012-2014: **Postdoctoral Researcher**, *Chemical Engineering Department, University of Patras (*Supervisor: Professor Panagiotis Lianos)

2007-2012: **Graduate Research Assistant**, Department of Engineering Sciences, Physics Sector, University of Patras *(*Supervisor: Professor Panagiotis Lianos)

D. FIELD OF RESEARCH INTEREST

My research activities focus on the area of photoinduced process systems engineering and, in particular, on photo(electro)catalytic processes for wastewater treatment, energy and hydrogen production and on the third generation photovoltaic solar cells.
In the field of photo(electro)catalysis, my research interest focuses on the following topics:
• Development of photocatalytic systems and processes for hydrogen and energy production through the decomposition of organic substances.
• Development of photocatalytic systems and processes for hydrogen and energy production through the decomposition of water using solar radiation
• Study of the mechanism of photocatalytic reactions.
• Development of innovative photocatalysts with increased absorption of the visible part of solar radiation

• Doping or combination of titanium dioxide with metals or metal oxides
• Development of dye sensitized solar cells photosensitized, both solid state and gel electrolyte structures
• Study of perovskite materials for their use as absorbers or holes transport materials in perovskite solar cells

LABORATORY EXPERIENCE

Design, development and operation of experimental devices and reactors for the study of photo(electro)catalytic processes.

- Preparation and characterization of nanophotocatalysts and electrocatalysts by various techniques.
  - ✓ TiO_2, CdS, CdSe, ZnS, ZnO, WO_3, g-C_3N_4, GO, $CH_3NH_3PbI_3$, $CsFAMAPbI_{3-x}Br_x$, NiO, RuO_2 Polypyrrole, metal electrocatalysts, ureasil electrolyte,
  - ✓ Sol-gel method, Polymerization, CBD, SILAR, Precipitation method, Wet-Chemical synthesis, Hydrothermal synthesis, electrodeposition

- Analytical techniques:

  - ✓ Raman spectroscopy
  - ✓ Atomic force microscopy (AFM)
  - ✓ Gas chromatography (GC)
  - ✓ Ultraviolet/Visible spectroscopy (FTIR, UV / vis)
  - ✓ Scanning electron microscopy (SEM)
  - ✓ Electrochemical characterization and development of solar cells (Voltammetry/ Impedance Spectroscopy / Electrodeposition)
  - ✓ Deposition techniques (Spin Coating, Dip Coating, Screen Printing, Doctor Blading)

- Operation and use of laboratory and mechanical equipment.

E. TEACHING EXPERIENCE

E.1 Teaching

(A) ***2021-22: Teaching Assistant,*** *School of Pedagogical & Technological Education (ASPETE)*, Department of Mechanical Engineering Educators, C*ourse: "**Environmental protection & anti-pollution technologies"*** (Winter Semester)

(B) 10/03/2020- 30/12/2020: ***Teaching Assistant,*** *School of Pedagogical & Technological Education (ASPETE)*, Department of Mechanical Engineering Educators, C*ourse: **"Renewable Energy Sources"***

Supervision of undergraduate student I. Andreou. Thesis: **"Electricity production by consuming wastes/biomass"**

(C) 26/09/2008 - 31/08/2012: ***Laboratory Assistant*** *in the Sector of Physics, Department of Engineering Sciences, University of Patras. Organizing and Teaching the laboratory courses **"Physics I"** and **"Physics II"**.*

E.2 Supervision Of Graduate Students And Doctoral Fellows

A. Supervision of Postdoctoral Researcher/PhD-Master Students N.C.S.R "Demokritos

1. Dr Balis Nikolaos, Postdoctoral Researcher, [granted by:NEROPHOS, HFRI (2018-2021)]

2. Dr Elsenety Mohamed, Postdoctoral Researcher, [granted by:NEROPHOS, HFRI (2018-2021)]

3. Gkini Konstantina (2015-2016, Master thesis)**. Thesis** «Perovskite materials for solar cells»

4. Givalou Lida, «Study and development of electrochemical systems for photovoltaic applications » (2017-PhD Thesis)

5. Gkini Konstantina, PhD candidate «Photovoltaic systems using perovskite structures » (2016-Today)

6. Prasanna Arvind, PhD Candidate [granted by: MAESTRO (Marie Curie) (2018-2019)]

B. Co-Supervision (with Prof. P. Lianos) University of Patras

1. Michailidi Melpomeni, «Converting Solar Energy to Electricity Using Photo-fuel cells», (2015-Master thesis)

2. Sfaelou Stavroula, «Study of photo-fuel cells for solar energy production consuming organic or inorganic wastes» (2016-PhD Thesis)

F. RESEARCH EXPERIENCE

F. A. SCIENTIFIC DIRECTOR

2018-2021: ***"Hydrogen and electricity production via water splitting in a tandem photoelectrochemical perovskite solar cell"–*** granted by the Hellenic Foundation for Research and Innovation **(180.000,00€)**, INN, NCSR "Demokritos"

F.B. PARTICIPATIONS IN SCIENTIFIC RESEARCH PROJECTS

01.03.2017-31.08.2017: **Post-doctoral Researcher,** N.C.S.R "Demokritos", Institute of Nanoscience and Nanotechnology **Research Funding Program:** Establishing a Multidisciplianary and effective Innovation and Entepreneurship Hub, in the framework of the Hellenic Republic-Siemens Settlement Agreement (full time)

01.09.2016-28.02.2017: **Post-doctoral Researcher,** N.C.S.R "Demokritos", Institute of Nanoscience and Nanotechnology: Establishing a Multidisciplianary and effective Innovation and Entepreneurship Hub (full time)

01.01.2016-31.08.2016: **Post-doctoral Researcher,** N.C.S.R "Demokritos", Institute of Nanoscience and Nanotechnology **Research Funding Program:** IKY fellowships of Excellence for Postgraduate Studies in Greece-Siemens Programme 2014-2015" in the framework of the Hellenic Republic-Siemens Settlement Agreement (full time)

01.11.2014-31.12.2015: **Post-doctoral Researcher,** N.C.S.R "Demokritos", Institute of Nanoscience and Nanotechnology **Research Funding Program:** Advanced Materials and Devices for Energy Harvesting and Management' project within **GSRT's KRIPIS** action, funded by Greece and the European Regional Development Fund of the European Union under NSRF 2007–2013 (full time)

01.04.2014-15.02.2015: Post-doctoral Researcher, N.C.S.R "Demokritos", Institute of Nanoscience and Nanotechnology Investing in knowledge society through the European Social Fund **Research Funding Program:**

Thales MIS 377756 (NANOSOLCEL). Investing in knowledge society through the European Social Fund "Innovative materials for nanocrystalline solar cells" (full time)

01.11.2012-28.02.2014: **Post-doctoral Researcher,** University of Patras, Dept. of Chemical Engineering **Research funding Program: Thales** MIS 379320. Investing in knowledge society through the European Social Fund. "Development of novel photo fuel cells for hydrogen and electricity production using solar radiation" (full time)

01.09.2010-01.11.2012: **Graduate Research Assistant**, University of Patras, Dept. of Engineering Sciences, **Research Funding Program: Heracleitus** *«Study of the photoelectrochemical production of hydrogen and electricity by using hybrid organic-inorganic structures»*, co-financed by the European Union (European Social Fund – ESF) and Greek national funds through the Operational Program "Education and Lifelong Learning" of the National Strategic Reference Framework (NSRF) (full time)

01.02.2009-30.06.2011: **Graduate Research Assistant**, University of Patras, Dept. of Engineering Sciences,Participation in the research project *«Application of nanotechnology in the energy business»* supported by a project funded by E.ON AG as part of the E.ON International Research Initiative (full time)

01.09.2008-31.12.2008: **Graduate Research Assistant**, University of Patras, Dept. of Engineering Sciences,Participation in the research project *«SES6-038889: ORGAPVNET: Coordination action towards stable and low-cost organic solar cell technologies and their application»*, supported by European Union (full time)

19.10.2007-31.03.2008: **Graduate Research Assistant**, University of Patras, Dept. of Engineering Sciences, Participation in the project "5NON-EU-521: Synthesis of photosensitive nanoparticles TiO_2-XNX in the form of powder or thin films and their application in the degradation of carbamates and organophosphate pesticides in water" financed by General Secretariat for Research and Technology (full time)

G. PROFESSIONAL SERVICES

1. Reviewer In Scientific Journals (Appendix B1)
2. **Editorial Board Member** of (i)"*International Journal of Nanomaterials and Nanostructures" (ii) "Coatings" (MDPI)*

H. HONORS AND AWARDS

2017: IKY–Siemens Scholarship for post-doctoral researchers "Innovative Photofuel Cells for absorption in the visible part of solar radiation"

2016: IKY–Siemens Scholarship for post-doctoral researchers «Novel Hybrid photovoltaic systems of high efficiency and increased stability"

HA. LANGUAGE SKILLS

- **Greek** (native language)

- **English** *(**GCEE** (O' Level) Degree University of London Grade B), Advance knowledge*

HB. COMPUTER KNOWLEDGE

- *Windows (Word, Excel, Power Point, Internet)*
- *Programming: FORTRAN 90/95*
- *Data analysis and graphing software Origin*

I. PUBLISHED WORK

I.1 Publications in Peer reviewed journals

- Papers in Scientific Journals and book chapters. **44**
  Abstracts and journals analysis (impact factors) are presented in the Appendix A a
  B (Table B2) respectively

I.2 Conference presentations

National/International Conferences **30**

J. CITATION REPORT

Time cited (*)

Sum of times cited	**1479**
Without self citations	**1386**
Hirsch Index (*h-index*)	**22**

(*)Source: Scopus (May 2021)

PUBLICATIONS

A. PUBLICATIONS in International Peer Reviewed Journals (*h-index* 21, total citations >1450, based on scopus)

1. *"Nanotubular Structures for Photocatalytic Degradation of Pharmaceuticals and Organic Contaminants of Emerging Concern",* M. Antoniadou, P.P. Falara, V. Likodimos, Current Opinion in Green and Sustainable Chemistry, *29* **(2021)** *100470*

2. "Novel Semiconductors for Energy Production via Electrochemical Processes", M. Antoniadou, N. Balis, P. Falaras, SVOA Materials Science & Technology, 2:4 **(2020)** 76-79.

3. *"Graphene Quantum Dot-TiO_2 Photonic Crystal Films for Photocatalytic Applications",* M.A. Apostolaki, A. Toumazatou, M. Antoniadou, E. Sakellis,E. Xenogiannopoulou, S. Gardelis, N. Boukos, P. Falaras, A. Dimoulas, V. Likodimos, Nanomaterials 10 **(2020)** *2566*

4. *"Boosting visible light harvesting and charge separation in surface modified TiO2 photonic crystal catalysts by CoOx nanoclusters",* A. Toumazatou, M. Antoniadou, E. Sakellis, D. Tsoutsou, S. Gardelis, G. E. Romanos, N. Ioannidis, N. Boukos, A. Dimoulas, P. Falaras, V. Likodimos, Materials Advances, DOI: 10.1039/D0MA00510J **(2020)**

5. *"Stability Improvement and Performance Reproducibility Enhancement of Perovskite Solar Cells Following (FA/MA/ Cs)$PbI_{3-x}Br_x$/$(CH_3)_3SPbI_3$ Dimensionality Engineering*", Mohamed Elsenety, Maria Antoniadou, Nikolaos Balis, Andreas Kaltzoglou, Labrini Sygellou, Anastasios Stergiou, Nikos Tagmatarchis, and Polycarpos Falaras, ACS Applied Energy Materials, 3**(2020)** 2465-2477

6. *«Synthesis, characterization of $((CH_3)_3S)_2SnI_{6-n}Cl_n$ and $((CH_3)_3S)_2SnI_{6-n}Br_n$ (n=1,2) perovskites and use in dye-sensitized solar cells»* M.M. Elsenety, M. Antoniadou, A. Kaltzoglou, A. G.

Kontos, A.I. Philippopoulos, C.A. Mitsopoulou, P. Falaras, Materials Chemistry and Physics 239 **(2020)** 122310

7. «Magnetically separable $TiO_2/CoFe_2O_4/Ag$ nanocomposites for the photocatalytic reduction of hexavalent chromium pollutant under UV and artificial solar light» A. Kaltzoglou; A.G Kontos; C. Athanasekou; E. Devlin; F.Katsaros; I. Ibrahim; L. Sygellou; M. Antoniadou; M. Perraki; N. Ioannidis; P.Tsakiridis; P. Falaras, Chemical Engineering Journal, 81**(2020)** 122730

8. *«High performance solid state solar cells incorporating CdS quantum dots and $CH_3NH_3PbI_3$ perovskite»*, L. Givalou, M.Antoniadou, A. Kaltzoglou, P. Falaras, Materials Today: Proceedings 19 **(2020)** 79–85

9. *«Bifunctional g-C_3N_4/WO_3 Thin Films for Photocatalytic Water Purification»* M. Antoniadou, M.K. Arfanis, I. Ibrahim, P. Falaras, Water 11**(2019)** 2439

10. *«Mixing cations and halide anions in perovskite solar cells»*, K.E. Gkini, M. Antoniadou, N. Balis, A. Kaltzoglou, A.G. Kontos, P. Falaras, Materials Today: Proceedings 19 **(2019)** 73–78

11. *«Novel photo-fuel cell that absorbs visible light»*, M. Antoniadou, L. Givalou, C.S. Karagianni, P. Falaras, Journal of Biotechnology 280S **(2018)** S32-S91.

12. *«Synthesis, characterization and use of highly stable trimethyl sulfonium tin halide defect perovskites in dye sensitized solar cells»* M.M. Elsenety, A. Kaltzoglou, M. Antoniadou, I. Koutselas, A.G. Kontos, P. Falaras, Polyhedron 150 **(2018)** 83-91

13. *«Stress tests on dye-sensitized solar cells with the Cs2SnI6 defect perovskite as hole-transporting material",* A. Kaltzoglou, D. Perganti, *M. Antoniadou*, A.G. Kontos, P. Falaras, Energy Procedia 102 **(2016)** 49–55

14. *«Electrodeposited cobalt-copper sulfide counter electrodes for highly efficient quantum dot sensitized solar cells»*, Givalou, L., Antoniadou, M., Perganti, D., Giannouri, M., Karagianni, C.-S., Kontos, A.G., Falaras, P., Electrochimica Acta 210 **(2016)** 630-638

15. *«Optical-Vibrational Properties of the Cs_2SnX_6 (X = Cl, Br, I) Defect Perovskites and Hole-Transport Efficiency in Dye-Sensitized Solar Cells»*, Kaltzoglou, A., Antoniadou, M., Kontos, A.G., Stoumpos, C.C., Perganti, D., Siranidi, E., Raptis, V., Trohidou, K., Psycharis, V., Kanatzidis, M.G., Falaras, P., Journal of Physical Chemistry C ,120 **(2016)** 11777-11785

16. *«Mixed-halide $Cs_2SnI_3Br_3$ perovskite as low resistance hole-transporting material in dye-sensitized solar cells»* Kaltzoglou A., Antoniadou M., Perganti D., Siranidi E., Raptis V., Trohidou K., Psycharis V., Kontos A. G., Falaras P., Electrochimica Acta 184 **(2015)** 466–474

17. *«Photovoltaic Performance and Stability of $CH_3NH_3PbI_{3-x}Cl_x$ Perovskites»,* Antoniadou M., Siranidi E., Vaenas N., Kontos A. G., Stathatos E., and Falaras P., J. Surf. Interfac. Mater. 2 **(2014)** 323-327

18. *«Quantum dot sensitized titania for photo-fuel-cell and for water splitting operation in the presence of sacrificial agents»***,** Antoniadou, M., Sfaelou, S., Lianos, P., Chemical Engineering Journal 254 **(2014)** 245–251

19. *«Hydrogen production by photocatalytic ethanol reforming using Eu- and S-doped anatase»,* Puskelova, J., Michal, R., Caplovicova, M., Antoniadou, M., Caplovic, L., Plesch, G. , Lianos, P., Applied Surface Science 305 **(2014)** 665-669

20. *«Photocatalytic hydrogen production using TiO_2-Pt aerogels»***,** Puskelova, J., Baia, L., Vulpoi, A., Baia, M., Antoniadou, M., Dracopoulos, V., Stathatos, E., Gabor, K., Pap, Z., Danciu, V. , Lianos, P., Chemical Engineering Journal 242 **(2014)** 96-101

21. *«Quantum dot sensitized titania as visible-light photocatalyst for solar operation of photofuel cells»***,** Sfaelou, S., Antoniadou, M., Dracopoulos, V., Bourikas, K., Kondarides, D.I., Lianos, P., Journal of Advanced Oxidation Technologies, 17 **(2014)** 59-65

22. *«Platinum-free photoelectrochemical water splitting»*, Antoniadou M., Sfaelou S., Dracopoulos V., Lianos P., Catalysis Communications, 43 **(2014)** 72–74

23. *«Solar Energy Conversion Using Photo-Fuel-Cells»*, Antoniadou M., Han C., Sfaelou S., Michailidi M., Dionysiou D. D., Lianos P., Science of Advanced Materials, 5 **(2013)** 1756-1763

24. *«Photocatalytic oxidation of ethanol using undoped and Ru-doped titania: Acetaldehyde, hydrogen or electricity generation»***.** Antoniadou M., Vaiano V., Sannino D., Lianos P., Chemical Engineering Journal, 224 **(2013)**144-148

25. *«Quantum Dot Sensitized Titania Applicable as Photoanode in Photoactivated Fuel Cells»*, Antoniadou M., Kondarides D.I., Dionysiou D.D. and Lianos P., Journal of Physical Chemistry C 116 **(2012)** 16901-16909

26. **«***Buckypaper as Pt-free cathode electrode in photoactivated fuel cells»,* Sfaelou S., Antoniadou M., Trakakis G., Dracopoulos V., Tasis D., Parthenios J., Galiotis C., Papagelis K., Lianos P., Electrochimica Acta 80 **(2012)** 399– 404

27. **«***One-step electrodeposition of polypyrrole applied as oxygen reduction electrocatalyst in Photoactivated Fuel Cells»,* Balis N., Dracopoulos V., Antoniadou M., Lianos P., Electrochimica Acta 70 **(2012)** 338– 343

28. *«Photocatalysis and photoelectrocatalysis using nanocrystalline titania alone or combined with Pt, RuO_2 or NiO co-catalysts»*, Antoniadou M., Panagiotopoulou P., Kondarides D.I., Lianos P., J. Appl. Electrochem. 42 **(2012)** 737, DOI 10.1007/s10800-012-0408-2

29. **«***A photoactivated fuel cell used as an apparatus that consumes organic wastes to produce electricity»*, Antoniadou M. and Lianos P., Photochem. Photobiol. Sci., 10 **(2011)** 431-435, DOI**:** 10.1039/C0PP00148A, Paper

30. *«Photocatalysis and photoelectrocatalysis using (CdS-ZnS)/TiO_2 combined photocatalysts»,* Antoniadou M., Daskalaki V.M., Balis N., Kondarides D.I., Kordulis C., Lianos P., Applied Catalysis B: Environmental 107 **(2011)** 188– 196

31. *«Aldol condensation products during photocatalytic oxidation of ethanol in a photoelectrochemical cell»*, Panagiotopoulou P., Antoniadou M., Kondarides D.I., Lianos P., Applied Catalysis B: Environmental 100 **(2010)** 124–132

32. *«Solid-state dye-sensitized solar cells made of multilayer nanocrystalline titania and poly (3-hexylthiophene)»,* Balis N., Dracopoulos V., Antoniadou M., Lianos P., Journal of Photochemistry and Photobiology A: Chemistry 214 **(2010)** 69–73

33. *«Solar Light-Responsive Pt/CdS/TiO_2 Photocatalysts for Hydrogen Production and Simultaneous Degradation of Inorganic or Organic Sacrificial Agents in Wastewater»,* Daskalaki V. M., Antoniadou M., Li Puma G., Kondarides D. I., Lianos P., *Environ. Sci. Technol.*, 44 **(2010)** 7200–7205

34. *«An efficient photoelectrochemical cell functioning in the presence of organic wastes»*, Antoniadou M., Kondarides D.I., Labou D., Neophytides S., Lianos P., Solar Energy Materials & Solar Cells 94 **(2010)** 592–597

35. *«Visible-light photocatalytic hydrogen production from ethanol–water mixtures using a Pt–CdS–TiO_2 photocatalyst»*, Strataki N., Antoniadou M., Dracopoulos V., Lianos P., Catalysis Today 151 **(2010)** 53–57

36. *«Cost-effective dye-sensitized solar cells based on commercial nanocrystalline titania and a ureasil gel electrolyte»*, Antoniadou M., Lianos P., Eur. Phys. J. Appl. Phys. 51 **(2010)** 33211

37. *«Production of electricity by photoelectrochemical oxidation of ethanol in a Photo Fuel Cell»*, Antoniadou M., Lianos P., Applied Catalysis B: Environmental 99 **(2010)** 307–313

38. *«Photoelectrochemical Oxidation of Organic Substances and Electricity Generation in the Presence of Nanocrystalline Titania Photocatalyst»*, Antoniadou M., Lianos P., Journal of Nanoscience and Nanotechnology 10 **(2010)** 6240–6244

39. *«Photoelectrochemical oxidation of organic substances over nanocrystalline titania: Optimization of the photoelectrochemical cell»,* Antoniadou M., Lianos P., Catalysis Today 144 **(2009)** 166–171

40. *«Photooxidation Products of Ethanol during Photoelectrochemical Operation Using a Nanocrystalline Titania Anode and a Two Compartment Chemically Biased Cell»*, Antoniadou M., Kondarides D. I., Lianos P., Catal. Lett. 129 **(2009)** 344–349

41. *«Near ultraviolet and visible light photoelectrochemical degradation of organic substances producing electricity and hydrogen»*, Antoniadou M., Lianos P., Journal of Photochemistry and Photobiology A: Chemistry 204 **(2009)** 69–74

42. *«Study of hybrid solar cells made of multilayer nanocrystalline titania and poly(3-octylthiophene) or poly-(3-(2-methylhex-2-yl)oxycarbonyldithiophene)»*, Antoniadou M., Stathatos E., Boukos N., Stefopoulos A., Kallitsis J., Krebs F.C., Lianos P., Nanotechnology 20 **(2009)** 495201 (9pp)

43. *«Photocatalytic and photoelectrochemical hydrogen production by photodegradation of organic substances»***,** Lianos P., Strataki N., Antoniadou M., Pure Appl. Chem. Vol.81, No. 8 **(2009)** 1441-1448.

44. *«Hydrogen and electricity generation by photoelectrochemical decomposition of ethanol over nanocrystalline titania»***,** Antoniadou M., Bouras P., Strataki N., Lianos P., International Journal of Hydrogen Energy 33 **(2008)** 5045–5051

AB. BOOK CHAPTERS

45. **Chapter 7***: «Photo-fuel cells. An alternative route for solar energy conversion, Materials and Processes for Solar Fuel Production»,* Maria Antoniadou and Panagiotis Lianos, Series: Nanostructure Science and Technology, Vol. 174 Subramanian, Ravi, Viswanathan, Balasubramanian, Lee, Jae Sung (Eds.) **2014**, XVI, 242 p. 135, SPRINGER [DOI 10.1007/978-1-4939-1628-3_7].

B. CONFERENCES PRESENTATIONS

1. ***"Metal Oxide Photocatalysts for Photoelectrochemical Energy Production"*** M. Antoniadou,, Michalis K. Arfanis and Polycarpos Falaras, Athens Conference on Advances in Chemistry, ACAC, 10-14 March 2021

2. "**Photoelectrochemical conversion of biomass wastes into renewable energy"** , *M. Antoniadou, N. Balis, A. Kaltzoglou, A.G. Kontos, P.Falaras, E-MRS Spring Meeting 2019, May 27-31, Nice, France*

3. "Titania/Absorber Interface Engineering in Perovskite Solar Cells Using a Metallated Porphyrin", K.E. Gkini , N. Balis, A.Verykios, M. Antoniadou, A.G. Kontos, A.G. Coutsolelos, M.Vasilopoulou, P.Falaras, *E-MRS Spring Meeting 2019, May 27-31, Nice, France*

4. ***"Stability Improvement of Perovskite Solar Cells Using 3D/1D Heterostructures of*** $MAFACsPbI_{3-x}Br_x/(CH_3)_3SPbI_3$***" ,*** *M.M. Elsenety, M. Antoniadou , N. Balis, A. Kaltzoglou, A.G. Kontos, P.Falaras, E-MRS Spring Meeting 2019, May 27-31, Nice, France*

5. ***"Thermal Stability Enhancement of Perovskite Solar Cells via Dye Sensitization of the Titania Compact Layer",*** *A.A. Zaky, N. Balis, A.G. Kontos, C. Athanasekou, M. Antoniadou, P.Falaras, E-MRS Spring Meeting 2019, May 27-31, Nice, France*

6. ***«Mixed cation perovskite for planar and mesoscopic solar cells»,*** K.E. Gkini, M. Antoniadou, N. Balis, A.G. Kontos and P. Falaras, Athens Conference on Advances in Chemistry, 30October–01November2018,UoA,Athens,Greece.

7. ***«High performance solid state solar cells incorporating CdS quantum dots and*** $CH_3NH_3PbI_3$***perovskite»,*** L. Givalou, A. Kaltzoglou, M. Antoniadou and P. Falaras, 15th International Conference on Nanosciences & Nanotechnologies (NN18), 3-6 July 2018, Thessaloniki,Greece.

8. ***«Mixing cations and halide anions in perovskite solar cells»***¨K.E.Gkini, M. Antoniadou, N. Balis, A. Kaltzoglou, A.G. Kontos, P. Falaras, 15th International Conference on Nanosciences & Nanotechnologies (NN18), 3-6 July 2018, Thessaloniki, Greece.

9. «Novel Photo-Fuel Cell that absorbs Visible Light», M. Antoniadou, L. Givalou, C.S. Karagianni, P. Falaras, European Biotechnology Congress, April 26-28, 2018, Athens, Greece.

10. ***«Stress tests for solar cells based on tin perovskites»***, A. Kaltzoglou, D. Perganti, M. Antoniadou, A.G. Kontos, P. Falaras, European Materials Research Society-Symposium T, (E-MRS) 2-6thMay2016,Lille,France

11. ***«Raman and Photoluminesence investigation of $CsSnI_3$ perovskite phase transitions»*** M.Arfanis, P. Falaras, A.G. Kontos, E. Siranidi, M.Antoniadou, S. Aggeli, P. Trikalitis, Y. Raptis, Hybrid and Organic Photovoltaic Conference (HOPV15) 10-13 May 2015, Rome, Italy

12. ***"Highly efficient quantum dot solar cells"***, Lida Givalou, Maria Antoniadou, Dorothea Perganti, Chaido-Stefania Karagianni, Athanassios G. Kontos, Polycarpos Falaras, Hybrid and Organic Photovoltaic Conference (HOPV15) 10-13 May 2015, Rome, Italy

13. ***"Vibrational and photovoltaic properties of $CH_3NH_3PbI_{3-x}Cl_x$ perovskites",*** Maria Antoniadou, Eirini Siranidi, Athanasios Kontos, Polycarpos Falaras, Hybrid and Organic Photovoltaic Conference (HOPV15), 10-13 May 2015, Rome, Italy

14. ***«Optimization of TiO_2 photoelectrode in Quantum Dot Solar Cells»,*** *L. Givalou, M. Antoniadou, A.G. Kontos, P. Falaras, 6th International Conference on Micro-Nanoelectronics, Nanotechnologies & MEMs (Micro & Nano 2015) Athens, 4-7 October 2015*

15. ***«Stress tests on solar cells with Cs_2SnX_6 (X= Cl, Br, I) perovskites as hole-transporting materials»****, A. Kaltzoglou, D. Perganti, M. Antoniadou, A.G. Kontos, P. Falaras, 6th International Conference on Micro-Nanoelectronics, Nanotechnologies & MEMs (Micro&Nano 2015) Athens, 4-7 October2015*

16. «New Materials For Photoelectrochemical Water Splitting And Hydrogen Production», *I. Tantis, M. Antoniadou, S. Sfaelou, P. Lianos, 8th European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA8), 25-28 June 2014, Thessaloniki, Greece.*

17. «Synthesis of CdS on TiO_2 films using different precursors», *S. Sfaelou, M. Antoniadou, P. Lianos,8th European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications (SPEA8),25-28June2014,Thessaloniki,Greece.*

18. «Study of parameters pertaining to upscaling photo-fuel-cells», *M. Antoniadou, S. Sfaelou, P. Lianos, 18th International Conference on Semiconductor Photocatalysis and Solar Energy Conversion (SPASEC-18), 17-21 November 2013, San Diego, California, USA.*

19. «Quantum dot sensitized titania for water splitting and photo-fuel-cell applications», *P. Lianos,M. Antoniadou, S. Sfaelou, 4th International Conference on Semiconductor Photochemistry (SP4),23-27June2013,Prague,CzechRepublic.*

20. «Alternative semiconductor sensitizers. The case of Organometal halides and BiOI», *S. Sfaelou,M. Antoniadou, N. Balis, A. Nikolakopoulou, P. Lianos, 3rd International Conference on SemiconductorSensitized and Quantum Dot Solar Cells, 9-11 June 2013, Granada, Spain.*

21. "Photofuel cell as an alternative route for Solar Energy Conversion", *M. Antoniadou, S. Sfaelou, P. Lianos, 1st Patras Innovation Quest, 08-09 Dec 2012, Patras, Greece.*

22. "The Photofuel cell for production of electricity consuming organic wastes", *S. Sfaelou, M. Antoniadou, P. Lianos, 3nd Scientific Conference, University network APYç (Sorbent materials development),22-23/6/2012,Patras,Greece*

23. "Alternative counter electrodes for a Pt-free photoelectrochemical water splitting", M. Antoniadou, S. Sfaelou, P. Lianos, International Conference on New Advances in Materials Research for Solar Fuels Production (SolarFuel13), 12-14 June 2013, Granada, Spain.

24. «Solar Energy conversion using photo-fuel-cells», *M. Antoniadou, S. Sfaelou, P. Lianos*, International Conference on New Advances in Materials Research for Solar Fuels Production (SolarFuel13),12-14June2013,Granada,Spain.

25. "Study of organometal halide perovskites as sensitizers in solid state solar cells", M. Antoniadou, G. Sfyri, P. Lianos, 3rd International Conference on Semiconductor Sensitized and Quantum Dot Solar Cells, 9-11 June 2013 Granada, Spain.

26. «Photoelectrocatalysis using nanocrystalline titania alone or combined with various cocatalysts», M. Antoniadou, P. Panagiotopoulou, D.I. Kondarides, D. Sannino, P. Lianos, 7th

European Meeting on Solar Chemistry and Photocatalysis: Environmental Applications, SPEA7, Porto,17-20June2012

27. ***«Photoactivated fuel cells. An alternative source of electricity that consumes water solublewastes»,*** M. Antoniadou, D.I. Kondarides, P. Lianos, 1st International Conference on Bio InspiredMaterials for Solar Energy Utilization (IC BIOSOL 2011), 12-17 September 2011, Chania-Crete.

28. ***«Photocatalytic and Photoelectrochemical H2 production using nanocrystalline TiO2»*****,** Maria Antoniadou and Panagiotis LIanos, 3rd Symposium of Green Chemistry and Sustainable Development,18-20 September 2009, Thessaloniki, Greece

29. ***«Photocatalytic hydrogen production using nanocrystalline titanium dioxide films»,*** N. Strataki, M. Antoniadou and P. Lianos, 5th European Meeting on Solar Chemistry and Photocatalysis:Environmental Applications, Palermo (Italy) October 4 – 8, 2008

30. ***«Photocatalytic hydrogen production in the presence of nanocrystalline titania»*** N. Strataki, M.Antoniadou and P. Lianos, , 1st International Conference from Nanoparticles & Nanomaterials to Nanodevices & Nanosystems (IC4N), Halkidiki (Greece), June 16 – 18, 2008

31. ***«Photoelectrochemical hydrogen production by photodegradation of organic/inorganic wastes»*** Maria Antoniadou, Panagiotis Lianos, 7th National Chemical Engineering Conference, 3-5 June 2009, Patra (Greece)

APPENDIX A

List of publications with abstracts

1. ***"Nanotubular Structures for Photocatalytic Degradation of Pharmaceuticals and Organic Contaminants of Emerging Concern",*** M. Antoniadou, P.P. Falara, V. Likodimos, Current Opinion in Green and Sustainable Chemistry, **(2021)** *Accepted*

Intensive research activity is currently underway aimed at designing and developing novel nano-photocatalytic materials via control of dimension, morphology, shape, porosity and surface area. It is now well established that dimensionality and nanomorphology are key parameters controlling and determining their optoelectronic properties and therefore their photocatalytic activity. Nanotubes are among the most interesting innovative photocatalysts developed using different synthetic and engineering routes, mainly based on solution-processed methods. The current work focuses on the activity of a variety of nanotubular structures (titania, carbon and their composites) for the photocatalytic degradation of pharmaceuticals and organic compounds of immerging concern. The materials activity was evaluated for the photodegradation of a variety of characteristic water pollutants of emerging concern by comparative studies under UV-visible and solar light, with special focus on a number of organic contaminants and dangerous non-biodegradable pharmaceuticals present in lakes, rivers, municipal effluents and water treatment plants.

2. "Novel Semiconductors for Energy Production via Electrochemical Processes", M. Antoniadou, N. Balis, P. Falaras, SVOA Materials Science & Technology, 2:4 **(2020)** 76-79.

This mini review summarizes the most recent advances in the field of photoactive materials employed in photoelectro-chemical energy conversion, including electricity generation and hydrogen production. This work provides a brief narrative of some novel nanostructured materials employed as photoanodes in photoelectrochemical systems along with a short description of their working principles. It highlights the latest progress in the field and has the ambition to be a short and useful guide for young and experienced researchers that are interested in.

3. "Graphene Quantum Dot-TiO_2 Photonic Crystal Films for Photocatalytic Applications", M.A. Apostolaki, A. Toumazatou, M. Antoniadou, E. Sakellis,E. Xenogiannopoulou, S. Gardelis, N. Boukos, P. Falaras, A. Dimoulas, V. Likodimos, Nanomaterials 10**(2020)** *2566*

Heterostructuring titania nanomaterials with graphene quantum dots (GQDs) has been attracting increasing attention as a promising, environmentally benign approach to improve charge separation and visible light harvesting of TiO_2 photocatalysts. In this work, surface functionalization of TiO_2 photonic crystals by blue luminescent GQDs (n-* band at ca. 350 nm) is demonstrated as a facile method to promote photocatalytic activity by the combination of slow photon-assisted light trapping with GQD-TiO2 interfacial electron transfer. TiO_2 inverse opal films fabricated by the co-assembly of polymer colloidal spheres with a hydrolized titania precursor were post-modified by impregnation in aqueous GQDs suspension without any structural distortion. Photonic band gap engineering by varying the inverse opal macropore size resulted in selective performance enhancement for both salicylic acid photocatalytic degradation and photocurrent generation under UV-Vis and visible, when red-edge slow photons overlapped with the composite's absorption edge, whereas stop band reflection was attenuated by the strong UVA absorbance of the GQD-TiO_2 photonic films. Photoelectrochemical and photoluminescence measurements indicated that the observed improvement, which surpassed similarly modified benchmark mesoporous P25 TiO_2 films, was further assisted by GQDs electron acceptor action and visible light activation to a lesser extent, leading to highly efficient photocatalytic films.

4. ***"Boosting visible light harvesting and charge separation in surface modified TiO_2 photonic crystal catalysts by CoOx nanoclusters",*** A. Toumazatou, M. Antoniadou, E. Sakellis, D. Tsoutsou, S. Gardelis, G. E. Romanos, N. Ioannidis, N. Boukos, A. Dimoulas, P. Falaras, V. Likodimos, Materials Advances, DOI: 10.1039/D0MA00510J **(2020)**

Photonic crystal structuring has emerged as a promising approach to improve the utilization of solar energy by metal oxide semiconductor photocatalysts based on the combination of slow-light, pore interconnectivity and high surface accessibility of macroporous periodic structures with judicious compositional modifications of the materials' properties. In this work, surface modification of photonic band gap engineered TiO_2 inverse opals fabricated by the convective evaporation-induced co-assembly technique was performed with nanoscale Co oxides using the chemisorption–calcination-cycle method in order to explore the interplay of metal oxide heterostructuring and photonic amplification for the development of visible light-activated photonic catalysts. Fine tuning of the films' photonic and electronic properties by controlling the inverse opal macropore size and Co oxides' loading and composition resulted in significant enhancement of the photocatalytic activity for organics decomposition under visible light, exceeding that of benchmark mesoporous TiO_2 films subjected to the same treatment. The underlying mechanism was related to the slow-photon-assisted light harvesting by low amounts of Co oxide nanoclusters that exert minimal effects on the inverse opal periodicity and texture, while enabling visible light electronic absorption and promoting charge separation via strong interfacial coupling on the nanocrystalline titania skeleton of the photonic crystals.

5. ***"Stability Improvement and Performance Reproducibility Enhancement of Perovskite Solar Cells Following (FA/MA/Cs) $PbI_{3-x}Br_x/(CH_3)_3SPbI_3$ Dimensionality Engineering*****",** Mohamed Elsenety, Maria Antoniadou, Nikolaos Balis, Andreas Kaltzoglou, Labrini Sygellou, Anastasios Stergiou, Nikos Tagmatarchis, and Polycarpos Falaras, ACS Applied Energy Materials, 3**(2020)** 2465-2477

Mixed halide hybrid perovskites are strong candidates for fabrication of efficient, stable and reproducible perovskite solar cells (PSCs). To restrain intrinsic volatility and ionic migration effects, we report for the first time a dimensionality engineering approach consisting of a (FA/MA/Cs) $PbI_{3-x}Br_x/(CH_3)_3SPbI_3$ (3D/1D) perovskite bilayer architecture, fabricated exclusively with solution processes. XRPD analysis showed no degradation of the 3D/1D composite structure after more than one month of exposure in ambient conditions, in contrast to the reference 3D samples (sole (FA/MA/Cs) $PbI_{3-x}Br_x$) which gradually decomposed to PbI_2. The 3D/1D bilayer structure further optimizes the corresponding absorber/hole transporting layer (HTL) interface of the PSCs, since the (FA/MA/Cs) $PbI_{3-x}Br_x$ perovskite layer acts as the primary absorber and the $(CH_3)_3SPbI_3$ top layer plays the role of a barrier against ionic migration/charge carrier recombination. The latter leads to significant stability improvement for non-sealed devices both under ambient conditions and after light stress, underscoring the potential of interface engineering for developing highly efficient and stable PSCs based on functional 3D/1D perovskite bilayers.

6. «Synthesis characterization of $((CH_3)_3S)_2SnI_{6-n}Cl_n$ and $((CH_3)_3S)_2SnI_{6-n}Br_n$ (n=1,2) perovskites and use in dye-sensitized solar cells» M.M. Elsenety, M. Antoniadou, A. Kaltzoglou, AG. Kontos, A.I Philippopoulos, C.A. Mitsopoulou, P.Falaras, Mater. Chem. And Phys. 239(2020)122310

New air-stable $((CH_3)_3S)_2SnI_{6-n}Cl_n$ and $((CH_3)_3S)_2SnI_{6-n}Br_n$ (n=1, 2) defect perovskites were synthesized and their physicochemical properties were established. Rietveld analysis on the recorded XRD patterns revealed the presence of cubic structural modification with a 0D network of [SnI6-nCln] and [SnI6-nBrn] octahedra. The vibrational and electronic properties of the mixed-anion based trimethylsulfoinum Tin (IV) perovskites investigated using Raman and UV–vis spectroscopy showed that upon substitution of Cl/Br for I, the electronic band gap slightly

increased, while the lattice vibrations were also largely affected. Density functional theory (DFT) calculations permitted to determine the density of states (DOS) distribution and corresponding band energy structures, confirming the obtained increase of direct band gap values with halogen substitution. The lead-free Sn(IV)-based compounds were successfully incorporated as hole transporting materials (HTMs) in sensitized nanocrystalline solar cells (DSCs). For these devices, power conversion efficiencies as high as 5% were obtained, under 1 sun (A.M. 1.5G) illumination. Electrochemical impedance spectroscopic analysis indicated that the maximum device performance is associated with high charge recombination resistance and low electron transfer resistance at dye/perovskite and perovskite/Pt interfaces, respectively

7. «Magnetically separable $TiO_2/CoFe_2O_4$/Ag nanocomposites for the photocatalytic reduction of hexavalent chromium pollutant under UV and artificial solar light» A. Kaltzoglou; A.G Kontos; C. Athanasekou; E. Devlin; F.Katsaros; I. Ibrahim; L. Sygellou; M. Antoniadou; M. Perraki; N. Ioannidis; P.Tsakiridis; P. Falaras, Chemical Engineering Journal (2019) *DOI: 10.1016/j.cej.2019.122730*

In this work, novel ternary catalysts $Ag/TiO_2/CoFe_2O_4$ were synthesized with variable ferrite content for the photocatalytic reduction of Cr^{+6} pollutant, under UV and solar light illumination. Both TiO_2 and $CoFe_2O_4$ (TCF) were synthesized using the sol-gel method followed by hydrothermal treatment to prepare the TCF composite. Silver nanoparticles were successfully loaded on the surface of TCF to get different Ag/TCF composites. The analysis of their crystal structure indicated the presence of pure anatase phase TiO_2, cubic $CoFe_2O_4$, and silver nanoparticles, in both XRD patterns and Raman spectra. It was found that the addition of silver nanoparticles to the titania/ferrite composite has a great contribution to the photocatalytic reduction of Cr^{+6} species. The photocatalytic reaction mechanism was studied by applying scavenging reaction process and spin trap experiments, revealing that photogenerated electrons were mainly responsible for the reduction of Cr^{+6} species. After the photocatalytic experiments, the composite catalyst can be easily separated from the reaction solution with a magnetic bar and re-used

8. ***«Bifunctional g-C_3N_4/WO_3 Thin Films for Photocatalytic Water Purification»*** M. Antoniadou, M.K. Arfanis, I. Ibrahim, P. Falaras, Water 11(2019) 2439

A bifunctional thin film photocatalyst consisting of graphitic carbon nitride on tungsten trioxide ($g\text{-}C_3N_4/WO_3$) is introduced for the improvement of photocatalytic activity concerning hexavalent chromium reduction and methylene blue dye removal in water, compared to the bare, widely used WO_3 semiconductor. A bilayered structure was formed, which is important for the enhancement of the charge carriers' separation. The characterization of morphological, structural, optoelectronic, and vibrational properties of the photocatalysts permitted a better understanding of their photocatalytic activity for both dye degradation and Cr^{+6} elimination in water and the analysis of the photocatalytic kinetics permitted the determination of the corresponding pseudo-first-order reaction constants (k). Trapping experiments performed under UV illumination revealed that the main active species for the photocatalytic reduction of Cr^{+6} ions are electrons, whereas in the case of methylene blue azo-dye (MB) oxidation, the activation of the corresponding photocatalytic degradation comes via both holes and superoxide radicals

9. ***"High performance solid state solar cells incorporating CdS quantum dots and $CH_3NH_3PbI_3$ perovskite",*** L. Givalou, M. Antoniadou, A. Kaltzoglou, P. Falaras, Materials Today: Proceedings19 (2019)79.

Since 2012, halide perovskites $CH_3NH_3PbX_3$ (X = Cl, Br, or I) have been the topic of intensive research due to their excellent structural, optical and electronic properties and their application to perovskite solar cells (PSCs). PSCs are a new type of third-generation photovoltaics presenting

low cost, ease of construction and power conversion efficiencies exceeding 22%, challenging the Si-based devices. This work describes a novel solution processed PSC structure: FTO/$TiO_{2(CL)}$/mpTiO_2/CdS/Perovskite/Spiro-MeOTAD/Ag, using co-sensitization of quantum dots (QDs) with perovskite materials. This new cell architecture improves the device performance and characteristics and gives us the opportunity to develop solid state QDs cells.

10. ***"Mixing cations and halide anions in perovskite solar cells",*** K.E. Gkini, M. Antoniadou,N. Balis, A. Kaltzoglou, A.G. Kontos, P. Falaras, Materials Today: Proceedings 19 **(2019)** 73–78

In this work we synthesized triple cation (A = Cs, FA, MA), mixed halide (X = I, Br, Cl) APbX3 compounds to develop perovskite solar cells (PSCs) with improved thermal stability as well as high power conversion efficiency. The effects of the cation combination and the mixing of halides in mesostructured PSCs have been thoroughly investigated. The presence of cesium results in greater stability, less impurities and higher reproducibility. Power conversion efficiencies of ~17% and ~13.5% were recorded for PSCs with I-Br and I-Cl compounds, respectively. Despite their lower efficiency, the I-Cl containing PSCs exhibit greater stability in ambient conditions.

11. **«Novel photo-fuel cell that absorbs visible light»**, M. Antoniadou, L. Givalou, C- S. Karagianni,, P. Falaras, Journal of Biotechnology 280S (2018) S32–S91
Photo-Fuel cells are photoelectrochemical cells that can produce useful forms of energy by photocatalytic degradation of organic wastes. TiO2 is the most successful photocatalyst but it is burdened with the disadvantage of the absorption by only UVA light. Thus, in the present study there have been efforts for its photo-activation through smaller energy band gap semiconductors that absorb in the visible part of solar spectrum. For TiO2 sensitization with quantum dots CdS, CdSe the low-cost SILAR method was used and sol-gel solutions were also prepared for its substitution by semiconductors like WO3 or BiVO4. The quality and efficiency of the cathode plays an equally important role as the performance of the photocatalyst. In this work metal chalcogenides and reduced graphene oxide have been prepared by electrodeposition and spin-coating methods respectively, for their use as counter electrodes. The efficiencies with the combination of the new photocatalysts and counter electrodes reached 8%, under visible light irradiation

12. ***«Synthesis, characterization and use of highly stable trimethyl sulfonium tin halide defect perovskites in dye sensitized solar cells»,*** M. M. Elsenety, A. Kaltzoglou, M. Antoniadou, I. Koutselas, A.G. Kontos, P. Falaras, Polyhedron 150 (2018) 83-91

We report here on the crystal structure and physical properties of $((CH_3)_3S)_2SnX_6$ (X = Cl, Br, I) compounds as well as the application of $((CH_3)_3S)_2SnI_6$ in dye-sensitized solar cells. Powder X-ray diffraction and Rietveld analysis show that the materials form a cubic structure with a 0D network of [SnX6] octahedra, which can be considered as a defect variant (AB0.5X3) of the perovskite archetype (ABX3). The electronic band gaps of $((CH_3)_3S)_2SnX_6$ were determined by UV-Vis reflectance spectroscopy at 4.1, 2.9 and 1.4 eV for X = Cl, Br, and I, respectively. The direct bandgap and its relative decrease in the order of light to heavy halide was independently verified by density-of-states calculations. According to Raman spectroscopy, the lattice vibrations also depend largely on the halogen atom. The air-stable and non-toxic $((CH_3)_3S)_2SnI_6$ compound was incorporated in electrolyte-free dye-sensitized solar cells based on the Z907 chromophore chemisorbed onto mesoporous titania electrodes. A power conversion efficiency of 5% is achieved for these photovoltaic devices, confirming efficient charge transport in the bulk $((CH_3)_3S)_2SnI_6$ and hole extraction at the perovskite-Pt interface.

13. ***«Stress tests on dye-sensitized solar cells with the Cs_2SnI_6 defect perovskite as hole-transporting material",*** A. Kaltzoglou, D. Perganti, *M. Antoniadou*, A.G. Kontos, P. Falaras, Energy Procedia 102 (2016) 49–55

Inorganic tin perovskites appear as highly efficient materials for dye-sensitized solar cells. Despite their promising characteristics such as low cost and lack of toxicity, the stability of the corresponding devices still remains an issue to be addressed. In the current study, the chemical reactivity of the defect perovskite Cs_2SnI_6 at various temperatures and under illumination as well as the ageing of Cs_2SnI_6-based solar cells are investigated. According to X-ray powder diffraction analysis, gradual decomposition of the perovskite in ambient air only occurs at temperatures above 80 °C. Dye-sensitized solar cells were fabricated using the Z907 metal-organic complex as photosensitizer and Cs_2SnI_6 as hole transporter on mesoporous TiO_2 substrate. The power conversion efficiency remains constant at 3.3% when the solar cell is stored at room temperature in the dark. Successive current voltage measurements after exposure of the device to 40 °C for up to 200 hours revealed a marked effect on the photovoltaic performance. Electrochemical impedance spectroscopy was also employed to identify the correlation between the photoelectrochemical properties and the relevant behavior of the device components upon ageing.

14. ***«Electrodeposited cobalt-copper sulfide counter electrodes for highly efficient quantum dot sensitized solar cells»***, Givalou, L., Antoniadou, M., Perganti, D., Giannouri, M., Karagianni, C.-S., Kontos, A.G., Falaras, P., Electrochimica Acta 210 **(2016)** 630-638

A series of novel composite Cobalt-Copper Sulfide (CoS-CuS) counter electrodes were developed for Quantum Dot Sensitized Solar Cells (QDSSCs) based on core-shell cadmium sulfide-cadmium selenide quantum dots. The new electrodes were prepared by one-step electrodeposition from an aqueous solution containing cobalt chloride ($CoCl_26H_2O$), copper chloride ($CuCl_22H_2O$) and thiourea. The composite electrodes present rough morphology consisting of CuS agglomerates on a CoS continuous nanowire network, allowing easy electron transfer across the CE-electrolyte interface. The corresponding QDSSCs demonstrate power conversion efficiencies (PCE) exceeding 5%, under one sun illumination. By increasing the mesoporous layer thickness, adding a scattering layer and adjusting the QDs deposition conditions, a PCE as high as 7.49% was obtained. These very promising results further justify and account for the innovative character of the composite CoS-CuS counter electrodes.

15. ***«Optical-Vibrational Properties of the Cs_2SnX_6 (X = Cl, Br, I) Defect Perovskites and Hole-Transport Efficiency in Dye-Sensitized Solar Cells»*****,** Kaltzoglou, A., Antoniadou, M., Kontos, A.G., Stoumpos, C.C., Perganti, D., Siranidi, E., Raptis, V., Trohidou, K., Psycharis, V., Kanatzidis, M.G., Falaras, P., Journal of Physical Chemistry C ,120 **(2016)** 11777-11785

We report the vibrational and optical properties of the 'defect' perovskites Cs_2SnX_6 (X = Cl, Br, I) as well as their use as hole-transporting materials in solar cells. All three air-stable compounds were characterized using powder X-ray diffraction and Rietveld refinement. Far-IR reflectance, Raman and UV-Vis spectroscopy as well as electronic band structure calculations show that the compounds are direct band gap semiconductors with a pronounced effect of the halogen atom on the size of the energy gap and the vibrational frequencies. Scanning electron microscopy and atomic force microscopy confirmed that the morphology of the perovskite films deposited from N,N-dimethylformamide solutions on TiO_2 substrates also strongly depends on the chemical composition of the materials. The Cs_2SnX_6 perovskites were introduced as hole-transporting materials in dye-sensitized solar cells, based on mesoporous titania electrodes sensitized with various organic and metal-organic dyes. The solar cells based on Cs_2SnI_6 HTM and the Z907 dye performed best with a maximum power conversion efficiency of 4.23% at 1 sun illumination. The higher performance of Cs_2SnI_6 is attributed to efficient charge transport in the bulk material and hole extraction at the perovskite-Pt interface, as evidenced by electrochemical impedance spectroscopy.

16. ***«Mixed-halide $Cs_2SnI_3Br_3$ perovskite as low resistance hole-transporting material in dye-sensitized solar cells»*** Andreas Kaltzoglou, M. Antoniadou, D. Perganti, E. Siranidi, V. Raptis, K. Trohidou, V. Psycharis, A. G. Kontos, P. Falaras, Electrochimica Acta 184 **(2015)** 466–474

The crystal structure and physicochemical properties of the mixed-anion perovskite $Cs_2SnI_3Br_3$ as well as its use as hole-transporting material in dye-sensitized solar cells have been investigated. The new air-stable compound was prepared from the ternary perovskites Cs_2SnBr_6 and Cs_2SnI_6 in solid state and was characterized by powder X-ray diffraction analysis and Rietveld refinement. Raman and UV–vis spectroscopies were employed to determine the vibrational and optical characteristics both in bulk form and upon deposition on a TiO_2 substrate. The effect of mixing Br and I atoms on the band structure and density of states was also evaluated with computational methods. The $Cs_2SnI_3Br_3$ perovskite was successfully incorporated as hole-transporting material (HTM) in solid-state dye-sensitized solar cells (DSCs) based on mesoporous nanostructured titania electrodes sensitized with metal-organic (N719, Z907) and organic (MK2, D35) dyes, reaching a maximum power conversion efficiency of 3.63% with the Z907 dye, at 1 sun illumination. At 0.1 sun illumination, hole transport limitations are avoided and the efficiency is raised up to 7.3%. The electrochemical characteristics of the fabricated solar cells were also studied with impedance spectroscopy and reveal significantly lower charge-transport resistance for the perovskite compared to conventional HTMs.

17. ***«Photovoltaic Performance and Stability of $CH_3NH_3PbI_{3-x}Cl_x$ Perovskites»,*** M. Antoniadou, E. Siranidi, N. Vaenas, A. G. Kontos, E. Stathatos, and P. Falaras, J. Surf. Interfac. Mater. 2 **(2014)** 323-327

The organic–inorganic methylammonium lead iodide $CH_3NH_3PbI_3$ hybrid and the partially chlorine substituted mixed halide $CH_3NH_3PbI_{3-x}Cl_x$ analogue have been prepared and compared as light harvesters in perovskite solar cells (PSCs). To account for the perovskites sensitivity in moisture, their stability was investigated by exposure in ambient atmosphere and the observed differences are discussed in terms of the materials vibrational properties and the device performance.

18. ***«Quantum dot sensitized titania for photo-fuel-cell and for water splitting operation in the presence of sacrificial agents»*****,** Antoniadou, M., Sfaelou, S., Lianos, P., Chemical Engineering Journal 254 **(2014)** 245–251

Photoelectrochemical cells have been constructed using quantum dot sensitized nanocrystalline titania photoanodes and were operated under photo-fuel-cell operation to produce electricity or water-splitting operation to produce hydrogen. In the first case, the cell functioned in the presence of an alkaline electrolyte using ethanol as fuel. The obtained data allowed to define the optimal thickness of the titania film, which was approximately 15 lm. Functional sensitizers were CdS or ZnSe combined with CdS. Small band gap quantum dot sensitizers like CdSe and PbS were not functional in photo-fuel-cells, owing to the limited oxidative power of their valence-band holes. For water-splitting operation, we mainly used a S^{2-}/SO_3^{2-} electrolyte. In that case, panchromatic sensitization is possible. Thus the photoanode, which gave the highest hydrogen production rate, was constructed by combining TiO_2/FTO with ZnS/CdSe/CdS quantum dots. Hydrogen was produced by applying an external bias of 0.5 V. In the absence of bias the quantity of hydrogen was very small. Hydrogen production rate was also very small in a purely alkaline environment with ethanol as fuel.

19. ***«Hydrogen production by photocatalytic ethanol reforming using Eu- and S-doped anatase»,*** Puskelova, J., Michal, R., Caplovicova, M., Antoniadou, M., Caplovic, L., Plesch, G. , Lianos, P., Applied Surface Science 305 **(2014)** 665-669

Pure or S- and Eu-doped nanocrystalline titania has been synthesized by precipitation in aqueous solutions of $TiSO_4$ in the presence of urea. Spherical aggregates were formed made of nanoparticles of size ranging between 33 and 46 nm. The samples were calcined at 700–750° C and this allowed for making materials with high degree of crystallinity. Doping preserved the anatase phase and allowed for a substantial value of specific surface in spite of the high temperature annealing. The photocatalytic capacity of doped and undoped samples was monitored by photocatalytic alcohol reforming and hydrogen production. Only samples co-doped with Pt nanoparticles produced hydrogen. Doping with either S, Eu or both gave much more efficient photocatalysts than the undoped samples. The superiority of doped samples is assigned to a larger specific surface and to the impeding of electron–hole recombination in that case.

20. ***«Photocatalytic hydrogen production using TiO_2-Pt aerogels»*****,** Puskelova, J., Baia, L., Vulpoi, A., Baia, M., Antoniadou, M., Dracopoulos, V., Stathatos, E., Gabor, K., Pap, Z., Danciu, V. , Lianos, P., Chemical Engineering Journal 242 **(2014)** 96-101

TiO_2–Pt aerogel composites have been synthesized by mixing sol–gel titania with Pt colloidal suspensions followed by supercritical drying. The highest specific surface achieved with these materials ranged between 550 and 600 $m^2\ g^{-1}$ before annealing and stayed relatively high, i.e. 162 $m^2\ g^{-1}$, after calcination. The concentration of Pt nanoparticles ranged between 0.3 and 1.0 wt.% while their size ranged between 5.75 and 6.5 nm. These composites were employed as photocatalysts for room-temperature photocatalytic reforming of ethanol and hydrogen production. The highest hydrogen production rate, 7.2mmol $H_2\ h^{-1}\ g^{-1}$, was obtained in the case of the smallest and most concentrated metal nanoparticles underlying the importance of the number of active sites on the TiO_2–Pt composites. This rate of hydrogen production is relatively high and reflects the relatively high specific surface of the employed photocatalysts.

21. ***«Quantum dot sensitized titania as visible-light photocatalyst for solar operation of photofuel cells»*****,** Sfaelou, S., Antoniadou, M., Dracopoulos, V., Bourikas, K., Kondarides, D.I., Lianos, P., Journal of Advanced Oxidation Technologies, 17 **(2014)** 59-65

Nanocrystalline titania photoanodes, sensitized with CdS, ZnS, CdSe, Sb_2S_3 and PbS quantum dots have been employed in photofuel cells functioning with alkaline electrolyte and ethanol as fuel. Ethanol was photo-catalytically oxidized producing electric current. It was found that medium band gap semiconductors, obtained by mixing ZnS and CdS, were the best sensitizers since they combine sensitization capacity in the Visible with sufficient oxidative power for oxidizing ethanol. However, in the presence of small band gap semiconductors, like CdSe, Sb_2S_3 and PbS, the oxidative power is diminished and the system demonstrates a poor behavior. Nanocrystalline titania sensitized by ZnS-CdS makes photoanodes with remarkable stability in the presence of ethanol, which acts as sacrificial agent.

22. ***«Platinum-free photoelectrochemical water splitting»*****,** M. Antoniadou, S. Sfaelou, V. Dracopoulos, P. Lianos, Catalysis Communications, 43 **(2014)** 72–74

Hydrogen can be produced by photoelectrochemical water splitting in the presence of S^{2-}/SO_3^{2-} sacrificial agent by using a Cu_2S electrocatalyst grown on brass by chemical treatment in HCl and polysulfide solution. Photoelectrochemical behavior of Cu_2S/brass was equivalent to that of Pt nanoparticles mixed with carbon black and deposited on a carbon cloth electrode, i.e. the electrocatalyst typically used in fuel cells and electrolyzers. Thus photoelectrochemical water splitting can be achieved in a Pt-free device. The Photoanode was made of nanocrystalline titania on FTO sensitized by quantum dots. Combined ZnS/CdSe/CdS quantum dots were by far more effective for hydrogen production than single-component CdS sensitizer.

23. ***«Solar Energy Conversion Using Photo-Fuel-Cells»*****,** Antoniadou Maria, Han Changseok, Sfaelou Stavroula, Michailidi Melpomeni, Dionysiou D. Dionysios, Lianos Panagiotis, Science of Advanced Materials, 5 **(2013)** 1756-1763
Photo-fuel-cells constitute an alternative means of solar energy conversion. A photo-fuel-cell is a photoelectrochemical cell, which produces electricity by photocatalytically degrading organic substances. Since photocatalysts are not selective towards the photodegradable substance, any organic material or a mixture of materials, including water-soluble wastes can play the role of the fuel. The photo-fuel-cell may be used to produce hydrogen by photoelectrocatalytic reforming of a fuel or by water splitting, however, this operation can be carried out only under bias. Production of electricity is an unbiased processes generating substantial electric power. More power can be generated by employing two-compartment cells, where the compartments are separated by an ion-transfer membrane. Some commercial products have been tried as ion-transfer membranes, however, this matter remains a technological challenge. The data presented in this work are based on a nanocrystalline titania photoanode sensitized in the Visible by quantum dot sensitizers.

24. ***«Photocatalytic oxidation of ethanol using undoped and Ru-doped titania: Acetaldehyde, hydrogen or electricity generation»*****.** Maria Antoniadou, Vincenzo Vaiano, Diana Sannino, Panagiotis Lianos, Chemical Engineering Journal, 224 **(2013)**144-148

Undoped and Ru-doped commercial nanocrystalline anatase has been studied as a photocatalyst for photocatalytic oxidation of ethanol in three different cases: in the gas phase producing acetaldehyde in the presence of oxygen, in the aqueous phase producing hydrogen by photocatalytic reforming and as a fuel in photoactivated fuel cells producing electricity. Doping with Ru affected photocatalyst behaviour in a different manner in the three cases. In the gas phase, the behaviour of the photocatalyst depended on the competition for free anatase sites where ethanol could be adsorbed and oxidized. Therefore the presence of increasing amounts of Ru resulted in slower ethanol conversion. In photocatalytic reforming, the dopant sites acted as electron scavengers facilitating reductive hydrogen formation. It was then found that the maximum hydrogen production rate was obtained in the presence of the maximum quantity of dopant. Finally, when ethanol was used as a fuel in a photoactivated fuel cell, since current depends on the availability of free charge carriers (electrons), again the highest current was produced in the absence of dopant and oxygen, since both these agents retain photogenerated electrons.

25. ***«Quantum Dot Sensitized Titania Applicable as Photoanode in Photoactivated Fuel Cells»*****,** Maria Antoniadou, Dimitris I. Kondarides, Dionysios D. Dionysiou and Panagiotis Lianos, Journal of Physical Chemistry C 116 **(2012)** 16901-16909

Quantum dot sensitized nanocrystalline titania has been studied as a photoanode in photoactivated fuel cells functioning in the presence of aqueous alkaline electrolyte containing ethanol as fuel. The results encourage the employment of quantum dot sensitized photoanodes absorbing visible radiation. The best choice of a photosensitizer is a combination of 75% CdS with 25% ZnS (atomic metal ratio). Other sensitizer combinations involving CdSe have also been examined. The target sought for in a photoactivated fuel cell is the photocatalytic oxidation of a fuel; therefore, it was concluded that utilization of panchromatic sensitizers is not the best choice for a photoanode, since too much of a decrease in the combined energy band gap leads to a decrease of the oxidative power of the material. The photocurrents produced by a cell using an optimized photoanode were high and corresponded to an incident photon to current conversion efficiency higher than 1. Such a situation is realized when the oxidation of the fuel proceeds by formation of radical intermediates and additional electron injections into the photocatalyst.

26. **«*Buckypaper as Pt-free cathode electrode in photoactivated fuel cells»,*** S. Sfaelou, M. Antoniadou, G. Trakakis, V. Dracopoulos, D. Tasis, J. Parthenios, C. Galiotis, K. Papagelis, P. Lianos, Electrochimica Acta 80 **(2012)** 399– 404

The possibility to substitute a standard Pt/carbon-black/carbon-cloth oxygen-reducing cathode by buckypaper has been studied in a photoactivated fuel cell. It was found that a buckypaper bearing NiO can very well compete with a standard cathode, thus offering a Pt-free alternative. The buckypaper was made through a process of epoxidation of multiwall carbon nanotubes while NiO was casted through a simple procedure employing surfactant templates.

27. «*One-step electrodeposition of polypyrrole applied as oxygen reduction electrocatalyst in Photoactivated Fuel Cells»,* Nikolaos Balis, Vassilios Dracopoulos, Maria Antoniadou, Panagiotis Lianos, Electrochimica Acta 70 **(2012)** 338– 343

This work studies the possibility of using electrodeposited polypyrrole as an oxygen reducing electrocatalyst in photoactivated fuel cells by substitution of the standard Pt/Carbon-Black electrocatalyst. Polypyrrole was deposited on carbon cloth electrodes by one-step electrodeposition that makes construction of a cell fast and easy. Polypyrrole was not a better oxygen-reducing catalyst than Pt/Carbon-Black but in view of the scarcity and the cost of the latter and the rather tedious procedure of fixing Pt/Carbon-Black on a carbon cloth electrode, polypyrrole becomes an interesting alternative.

28. *«Photocatalysis and photoelectrocatalysis using nanocrystalline titania alone or combined with Pt, RuO_2 or NiO co-catalysts»*, Maria Antoniadou, Paraskevi Panagiotopoulou, Dimitris I. Kondarides, Panagiotis Lianos, J. Appl. Electrochem. 42 **(2012)** 737, DOI 10.1007/s10800-012-0408-2

Photocatalytic mineralization of ethanol in the presence of oxygen has been studied in aqueous photocatalyst suspensions by employing either pure nanocrystalline titania or TiO_2 combined with Pt, RuO_2 or NiO co-catalysts. Combined photocatalysts demonstrated a diverse behavior. Highest mineralization rates were obtained with Pt/TiO_2 and lowest with RuO_2/TiO_2 and NiO/TiO2. These results were related with the photocatalysts' behavior when used as photoanodes for the production of electricity in a photoactivated fuel cell running with ethanol as fuel. The highest current was obtained with pure titania. The current dropped in the case of Pt/TiO_2 and became much lower in the case of RuO_2/TiO_2 and NiO/TiO_2 photoanodes. Both current and voltage were lower in the presence of oxygen than in its absence. It is concluded that the presence of electron scavengers, like O_2, and/or the use of efficient photocatalysts, like titania-supported Pt, yield less electric power but assist ethanol mineralization process.

29. «*A photoactivated fuel cell used as an apparatus that consumes organic wastes to produce electricity»* Maria Antoniadou and Panagiotis Lianos, Photochem. Photobiol. Sci., 10 **(2011)** 431-435, DOI**:** 10.1039/C0PP00148A

A two-compartment photoelectrochemical cell has been constructed and employed as a photoactivated fuel cell that can consume organic material to produce electricity. The cell comprises of a fluorine-doped tin oxide transparent anode electrode supporting a nanocrystalline titania photocatalyst, a Pt/carbon-black electrocatalyst deposited on a carbon cloth as the cathode and a porous membrane (glass frit) separating the two compartments. Both the anode and cathode compartments contain 1.0M NaOH, but the anode compartment also contains the photodegradable organic substance. The cell runs without any external bias, only by UVA (black light) irradiation or by natural solar light. Glycerol and two higher polyols, xylitol and sorbitol, were tested as fuels. Both the open-circuit voltage and the short-circuit current depended on the polyol concentration up to a saturation value. The maximum current density was around 0.8 mA cm^{-2}, calculated over the anode active geometrical area, and maximum open-circuit voltage was around 1.3 V. For quasi-monochromatic incident radiation (363 nm wavelength), the above maximum current density corresponded to an external quantum efficiency (IPCE%) of 77%. The fill factor of the cell was relatively small but improved when a thin cell design was applied. All

three studied polyols gave similar data for the same molar concentration, suggesting that photodegradation possibly proceeds by steps affecting a single hydroxyl group at a time.

30. ***«Photocatalysis and photoelectrocatalysis using (CdS-ZnS)/TiO_2 combined photocatalysts»,*** Maria Antoniadou, Vasileia M. Daskalaki, Nikolaos Balis , Dimitris I. Kondarides, Christos Kordulis, Panagiotis Lianos, Applied Catalysis B: Environmental 107 **(2011)** 188– 196

Powdered composite CdS-ZnS photocatalysts of variable composition have been synthesized by a co-precipitation method and were used as photocatalysts to produce hydrogen and as photoelectrocatalysts to produce electricity. Results of catalyst characterization show that composite sulphide photocatalysts form solid solutions and that their band gap energy can be tuned between that of ZnS (3.5 eV) and that of CdS (2.3 eV) by varying Cd (or Zn) content. The composite materials can photocatalytically produce substantial quantities of molecular hydrogen in the presence of sulphide–sulfite ions as sacrificial electron donors. Photocatalytic performance is significantly improved when small amounts of Pt crystallites are deposited on the photocatalyst surface. The rate of hydrogen production over the Pt-free CdS-ZnS powders depends on Cd (or Zn) content and is generally much higher for the composite materials than for pure CdS or ZnS. Pure semiconductors were found to be very poor photocatalysts under the present experimental conditions. Furthermore, two specific photocatalyst compositions, i.e., 67% and 25% CdS, gave maximum hydrogen production rates. An analogous behavior was observed when the same powders were used to make photoanode electrodes since both the rate of hydrogen ion reduction and the current flow are proportional to the number of photogenerated electrons. Composite CdS-ZnS photocatalysts were also applied by successive ionic layer absorption and reaction on TiO_2 films deposited on FTO electrodes. The obtained materials were used as photoanodes in a two-compartment photoelectrocatalysis cell filled with a basic electrolyte and with ethanol as sacrificial electron donor (fuel). The (CdS-ZnS)/TiO_2 photoanodes demonstrated a qualitatively similar behavior as CdS-ZnS photocatalysts. Thus 75%CdS–25%ZnS over TiO_2 was a better electrocatalyst than 100%CdS over TiO_2. When CdS-ZnS photocatalysts were combined with titania, they mainly functioned as visible-light-photosensitizers of this large band-gap semiconductor.

31. ***«Aldol condensation products during photocatalytic oxidation of ethanol in a photoelectrochemical cell»,*** P. Panagiotopoulou, M. Antoniadou, D.I. Kondarides, P. Lianos, Applied Catalysis B: Environmental 100 **(2010)** 124–132

Electric current was produced in a photoelectrochemical cell during photocatalytic oxidation of ethanol, which was used as a representative organic compound present in wastewater from biomass processing industries. Thus, the cell behaved as a PhotoFuelCell that consumed waste material to produce electricity. The cell consisted of two compartments separated by a silica frit. The anode electrode was a Fluorine-doped Tin Oxide transparent electrode bearing nanocrystalline titania Degussa P25, applied as a paste and calcined at 550 ° C. The cathode electrode was a carbon-cloth bearing Pt/Carbon-Black catalyst. The electrolyte was 1.0M NaOH. When 20%v. ethanol was added in the anode compartment, the cell gave 0.75mA/cm^2 short-circuit current density (calculated over 12cm^2 electrode area) and 1.1V open-circuit voltage. The anode compartment of the cell was operated under three different conditions: (1) under continuous air flow, i.e. oxygen-rich conditions; (2) under Ar flow, i.e. anaerobic conditions; and (3) exposed to ambient air but without any gas flow through the cell, i.e. oxygen-deficient, mass transfer limited conditions. In the latter two cases, the oxidation of ethanol and its photo-oxidation products was incomplete and resulted in aldol condensation reactions that produced various aldehydes, some of them of high molecular weight and insoluble. It was concluded that in order to avoid such reactions, which impede mineralization process, measures should be taken for continuous oxygen supply and for optimal combination of the quantity of the photocatalyst and

the concentration of the photodegradable substance. Thus only 1%v. ethanol can give 75% of the maximum current obtained in the presence of large ethanol concentration.

32. ***«Solid-state dye-sensitized solar cells made of multilayer nanocrystalline titania and poly (3-hexylthiophene)»,*** N. Balis, V. Dracopoulos, M. Antoniadou, P. Lianos, Journal of Photochemistry and Photobiology A: Chemistry 214 **(2010)** 69–73

Solid-state dye-sensitized solar cells have been made using nanocrystalline titania, a dye sensitizer and poly(3-hexylthiophene). The main issue in the construction of such cells is ensuring sufficient interface between the oxide and the organic phase. In the present work, improved results were obtained by employing multilayer nanocrystalline titania made of a bottom densely packed layer and a top open structure of varying thickness. The cells were assembled under ambient conditions using silver paste as counter electrode. Thus they were very easy and simple to make. Cells demonstrated a transient behaviour characterized by increase in the open-circuit voltage and decrease in the short-circuit current.

33. ***«Solar Light-Responsive Pt/CdS/TiO_2 Photocatalysts for Hydrogen Production and Simultaneous Degradation of Inorganic or Organic Sacrificial Agents in Wastewater»,*** V. M. Daskalaki, M. Antoniadou, G. Li Puma, D. I. Kondarides, P. Lianos, *Environ. Sci. Technol.*, 44 **(2010)** 7200–7205

Photocatalytic degradation of waste material in aqueous solutions and simultaneous production of hydrogen was studied with the double purpose of environmental remediation and renewable energy production. Both powdered and immobilized Pt/CdS/TiO_2 photocatalysts were used to oxidize model inorganic (S^{2-}/SO_3^{2-}) and organic (ethanol) sacrificial agents/ pollutants in water. Powdered Pt/CdS/TiO_2 photocatalysts of
variableCdScontent (0-100%) were synthesized by precipitation of CdS nanoparticles on TiO_2 (Degussa P25) followed by deposition of Pt (0.5 wt %) and were characterized with BET, XRD, and DRS. Immobilized photocatalysts were deposited either on plain glass slides or on transparent conductive fluorine doped SnO_2 electrodes. The results show that it is possible to produce hydrogen efficiently (20% quantum efficiency at 470 nm) by using simulated solar light and by photocatalytically consuming either inorganic or organic substances. CdS-rich photocatalysts are more efficient for the photodegradation of inorganics, while TiO_2-rich materials are more effective for the photodegradation of organic substances.

34. ***«An efficient photoelectrochemical cell functioning in the presence of organic wastes»*****,** Maria Antoniadou, Dimitris I. Kondarides, Diamantoula Labou, Stylianos Neophytides, Panagiotis Lianos, Solar Energy Materials & Solar Cells 94 **(2010)** 592–597

This work presents a design and studies the function of a photo-fuelcell, which can photocatalytically consume organic substances to produce electricity. The design resembles hydrogen fuel cells but, in the present case,hydrogen ions are produced photocatalytically in the presence of nanocrystalline titania. Results are presented for ethanol and glycerol but many other substances can be used as well. The cell can function in natural solar light by exploiting the UV portion of the solar spectrum. The produced current was enhanced when titania was combined with cadmium sulphide, which absorbs visible light.

35. ***«Visible-light photocatalytic hydrogen production from ethanol–water mixtures using a Pt–CdS–TiO_2 photocatalyst»*****,** Nikoleta Strataki, Maria Antoniadou, Vassilios Dracopoulos, Panagiotis Lianos, Catalysis Today 151 **(2010)** 53–57

Hydrogen was produced by photocatalytic treatment of water–ethanol mixtures. Nanocrystalline titania films, made of commercial Degussa P25, were deposited on transparent conductive glass slides (electrodes) bearing a fluorine-doped tin oxide (FTO) layer. The titania film covered 2/3 of

the area of the electrode. On the remaining 1/3 of the area, Pt was deposited by solution casting. Finally, CdS was deposited on nanocrystalline titania. This configuration, which, in reality acts as a photoelectrochemical cell with short-circuited anode and cathode, was used to photocatalytically treat water–ethanol mixtures and produce hydrogen under Visible-light irradiation. The conductive substrate was necessary to drain photogenerated electrons and channel them to the Pt-covered area where reduction interactions took place. The CdS/n-TiO_2 was necessary for Visible-light response. Spatial separation of Pt from CdS/n-TiO_2 was chosen because the mixture of all three agents, i.e., titania, CdS and Pt was found incompatible. In the absence of ethanol, hydrogen production was very slow. In the presence of ethanol, the quantity of hydrogen increased by about an order of magnitude.

36. ***«Cost-effective dye-sensitized solar cells based on commercial nanocrystalline titania and a ureasil gel electrolyte»*****,** M. Antoniadou, P. Lianos, Eur. Phys. J. Appl. Phys. 51 **(2010)** 33211

Nanocomposite organic-inorganic dye-sensitised solar cells have been constructed by using solution processed materials that are easily deposited, they do not necessitate sealing or encapsulation and offer satisfactory efficiency. The main components of the cell are a nanocrystalline titania layer made of commercial Degussa P25 and a solid gel electrolyte made of a ureasil precursor. Details on cell construction are given and show that the whole procedure can be upscaled for massive production.

37. ***«Production of electricity by photoelectrochemical oxidation of ethanol in a Photo Fuel Cell»*****,** Maria Antoniadou, Panagiotis Lianos, Applied Catalysis B: Environmental 99 **(2010)** 307–313

Photocatalytic oxidation of ethanol was carried out in a non-biased photoelectrochemical cell at high pH. The cell was made of two compartments separated by a silica frit, both filled with aerated NaOH electrolyte. The anode electrode bore multilayer nanocrystalline titania, made of either commercial Degussa P25, sol–gel synthesized titania or both. The cathode electrode was made of carbon cloth carrying Carbon Black and Pt as catalyst. When the anode was excited by UVA radiation (363 nm), the cell produced electricity very efficiently. The open-circuit voltage was 0.88V in the absence and almost 1.2V in the presence of ethanol. The current increased by more than an order of magnitude by adding ethanol, showing that it is much more efficient to oxidize ethanol than to oxidize (split) water. The performance of the cell improved when a compact titania layer was introduced between the FTO electrode and the thick photocatalytic layer. Ethanol was used as a model fuel but the cell can run on many other organic substances as well. The cell can be used as a source of renewable electricity, by consuming organic wastes under photo-excitation, thus making a PhotoFuelCell.

38. ***«Photoelectrochemical Oxidation of Organic Substances and Electricity Generation in the Presence of Nanocrystalline Titania Photocatalyst»*****,** Maria Antoniadou and Panagiotis Lianos, Journal of Nanoscience and Nanotechnology 10 **(2010)** 6240–6244

A chemically biased, two compartment cell has been used to photoelectrochemically degrade several substances and produce electricity. The photoanode of the cell was made of nanocrystalline Titania deposited on a conductive transparent fluorine-doped tin oxide electrode. The dark cathode was made of an identical electrode as the photoanode with Pt nanoparticles deposited on the nanocrystalline Titania film. The photoanode was activated by UVA radiation emitted by Black-light tubes or directly by natural (Solar) light. Photo-oxidation of several substances produced electricity. Efficiency calculations have been made in all studied cases.

39. ***«Photoelectrochemical oxidation of organic substances over nanocrystalline titania: Optimization of the photoelectrochemical cell»,*** Maria Antoniadou, Panagiotis Lianos, Catalysis Today 144 **(2009)** 166–171

The photocatalyzed oxidation of various organic substances has been studied in a two compartment, chemically biased photoelectrochemical cell. The organic substances studied were either derivatives of biomass and, generally, of natural products or they were potential water pollutants, like surfactants. The purpose of the study was the assessment of the feasibility of employing solar radiation to produce electricity with simultaneous water cleaning or consumption of surplus biomass derivatives. The study includes optimization of the photoelectrochemical cell by using different types of cathode electrodes and a standard nanocrystalline titania anode.

40. ***«Photooxidation Products of Ethanol during Photoelectrochemical Operation Using a Nanocrystalline Titania Anode and a Two Compartment Chemically Biased Cell»*****,** Maria Antoniadou, Dimitris I. Kondarides, Panagiotis Lianos, Catal. Lett. 129 **(2009)** 344–349 .

Production of hydrogen and/or electricity by photocatalytic treatment of aqueous ethanol solutions has been investigated in a two compartment chemically biased photoelectrochemical cell, employing commercial nanocrystalline Titania as photoanode and Pt as cathode. Results show that hydrogen is produced during photooxidation of ethanol by cathode reduction and by means of a flow of external electric current. The performance of the cell decreased after several hours of operation, most possibly due to the formation of hydrocarbons of higher molecular weight. This is contrary to simple photocatalytic ethanol oxidation where complete mineralization of alcohol is observed.

41. ***«Near ultraviolet and visible light photoelectrochemical degradation of organic substances producing electricity and hydrogen»*****,** Maria Antoniadou, Panagiotis Lianos, Journal of Photochemistry and Photobiology A: Chemistry 204 **(2009)** 69–74

A two-compartment, chemically biased photoelectrochemical cell was used to photodegrade several organic substances and produce electricity and hydrogen. The photoanode of the cell was based on commercial nanocrystalline titania, which may be functionalized with CdS to absorb Visible light. The dark cathode was made also of commercial nanocrystalline titania with cast Pt nanoparticles. The cell was run under Near Ultraviolet or Visible radiation and the efficiencies in the two cases have been compared. Short chain-length alcohols and glycerol produced the highest energy yield but water-soluble waste materials are also interesting for the same purpose. The overall efficiency of cells made by CdS-functionalized titania was higher than those made of pure titania. However, larger currents were obtained with pure TiO2 under Near Ultraviolet excitation. Under anaerobic conditions, molecular hydrogen can be produced at the dark cathode by the reduction of hydrogen ions generated at the photoanode.

42. ***«Study of hybrid solar cells made of multilayer nanocrystalline titania and poly(3-octylthiophene) or poly-(3-(2-methylhex-2-yl) oxycarbonyldithiophene)»*****,** Maria Antoniadou, Elias Stathatos, Nikolaos Boukos, Andreas Stefopoulos, Joannis Kallitsis, Frederik C Krebs and Panagiotis Lianos, Nanotechnology 20 **(2009)** 495201 (9pp)

Hybrid solar cells have been constructed by using nanocrystalline titania and hole-transporting polymers. Titania was deposited on fluorine-doped tin-oxide transparent electrodes in three layers: a blocking layer and two nanostructured layers, giving densely packed or open structures. Open structures produced higher currents due to better polymer penetration and larger oxide–polymer interface. Cells based on the dithiophene-unit-containing polymer gave higher open-circuit voltage. Efficient cells could be made only in the presence of a dye sensitizer and a lithium salt. Cells were neither sealed nor encapsulated and their components were deposited under

ambient conditions except for the metal back electrode, which was deposited under vacuum. Cells demonstrated a transient behavior in two stages: initially an increase of both current and voltage followed by an increase in voltage and a drop in current. Both quantities were stabilized at values approximately established within a few days. These values remained stable for several months when the cells were stored in the dark.

43. ***«Photocatalytic and photoelectrochemical hydrogen production by photodegradation of organic substances»*****,** P. Lianos, N. Strataki, M. Antoniadou, Pure Appl. Chem. Vol.81, No. 8 **(2009)** 1441-1448.

Commercial nanocrystalline titania (titanium dioxide, TiO_2) has been used to make TiO_2 films, which were employed to photodegrade several organic substances under photocatalytic (PC) or photoelectrochemical (PEC) operation. Hydrogen was produced during both operations while electricity was additionally produced during the PEC operation. Both processes were studied as typical examples of the current trend in the effort to produce useful forms of energy by photodegradation of organic waste materials.

44. ***«Hydrogen and electricity generation by photoelectrochemical decomposition of ethanol over nanocrystalline titania»*****,** Maria Antoniadou, Panagiotis Bouras, Nikoleta Strataki, Panagiotis Lianos International Journal of Hydrogen Energy 33 **(2008)** 5045–5051

Photoelectrochemical decomposition of ethanol has been carried out in a two-electrode chemically biased photoelectrochemical cell by employing commercial nanocrystalline titania deposited on a conductive transparent electrode as photoanode. Hydrogen was generated in the Pt cathode compartment. The quantity of generated hydrogen, the current flow, the cell IV characteristics and the cell overall efficiency have been examined.

BOOK CHAPTERS

45. Chapter 7: «*Photo-fuel cells. An alternative route for solar energy conversion, Materials and Processes for Solar Fuel Production»,* Maria Antoniadou and Panagiotis Lianos, Series: Nanostructure Science and Technology, Vol. 174 Subramanian, Ravi, Viswanathan, Balasubramanian, Lee, Jae Sung (Eds.) **2014**, XVI, 242 p. 135, SPRINGER [DOI 10.1007/978-1-4939-1628-3_7].

The present work, introduces photo-fuel cells as an alternative means of solar energy conversion with simultaneous degradation of water soluble wastes. A photo-fuel cell takes the structure of a standard photoelectrochemical cell. The photoanode carries the photocatalyst, which is a nanostructured oxide semiconductor, typically, nanoparticulate titania combined with a quantum dot sensitizer, which provides functionality in the Visible. Only medium band gap semiconductors, like CdS or combined CdS-ZnS may act as sensitizers. Low band gap semiconductors like CdSe or PbS cannot be employed as sensitizers because of their low oxidation capacity that affects the oxidation capacity of the combined photocatalyst. This is important since the photo-fuel cell functions by photocatalytic degradation of the fuel and its functionality is preserved thanks to the sacrifice of the fuel. The principal function of the photo-fuel cell is to produce electricity; however, it may also be used to produce solar fuels, for example, hydrogen. In that case, the cell functions only under bias. When it is operated to solely produce electricity, then the cathode electrode must be aerated. The present work is a short review of our recent experience in the study of photo-fuel-cells and proposes some measures for the improvement of their performance.

APPENDIX B

TABLE B1 REVIEWER IN SCIENTIFIC JOURNALS

A/A	Journal	Publisher
1	Applied Catalysis B: Environmental	Elsevier
2	Catalysis Today	Elsevier
3	International Journal of Photoenergy	Hindawi
4	Nanomaterials	MDPI
5	Photochemical & Photobiological Sciences	RSC
6	Crystals	MDPI

TABLE B2 NUMBER OF PUBLICATIONS PER JOURNAL AND IMPACT FACTORS [(1)]

Journal	Impact Factor	Number of Publications
Electrochimica Acta	6.215	4
Chemical Engineering Journal	10.652	4
Applied Catalysis B: Environmental	16.683	3
Journal of Physical Chemistry C	4.536	2
Catalysis Today	5.825	2
Journal of Photochemistry and Photobiology A: Chemistry	3.306	2
Current Opinion in Green and Sustainable Chemistry	5.165	1
ACS Applied Energy Materials	*4.473*	1
Nanomaterials	4.324	1
Environmental Science and Technology	7.864	1
Solar Energy Materials & Solar Cells	6.984	1
Nanotechnology	3.551	1
Catalysis Communications	3.612	1
Journal of Biotechnology	*3.163*	1
Materials Chemistry And Physics	*3.408*	1
Pure and Applied Chemistry	5.294	1
International Journal of Hydrogen Energy	4.939	1
Science of Advanced Materials	1.671	1
Applied Surface Science	6.182	1
Catalysis Letters	2.799	1
Photochemical & Photobiological Sciences	2.344	1
Journal of Applied Electrochemistry	2.384	1
Polyhedron	2.067	1
Water	*2.721*	1
Journal of Advanced OxidationTechnologies	1.230	1
Journal of Nanoscience and Nanotechnology	1.483	1
Energy Procedia	1.400	1
European. Physical Journal Applied Physics	0.762	1
Journal of Surfaces and Interfaces of Materials	*Not available*	1
Materials Today Proceedings	*Not available*	2
Materials Advances	*Not available*	1
SVOA Materials Science & Technology	*Not available*	1

[(1)] Source: Scopus