NEW FABRICATION CONCEPT OF SILVER NANOWIREPOLYANILINE TRANSPARENT, CONDUCTIVE AND FLEXIBLE ELECTRODES FOR SOLAR CELLS

Goal of the project

The aim of the project is to develop transparent, conductive and flexible electrodes for solar cells based on silver nanowire/polyaniline hybrid materials and to offer a new technical solution to decrease the sheet resistance of the silver nanowires embedded in the polymer matrix. Low melting point metallic nanoparticles (In and Sn) will be deposited on the surface of silver nanowires, allowing to weld the nanowires and to obtain a network with high electrical conduction paths.

Short description of the project

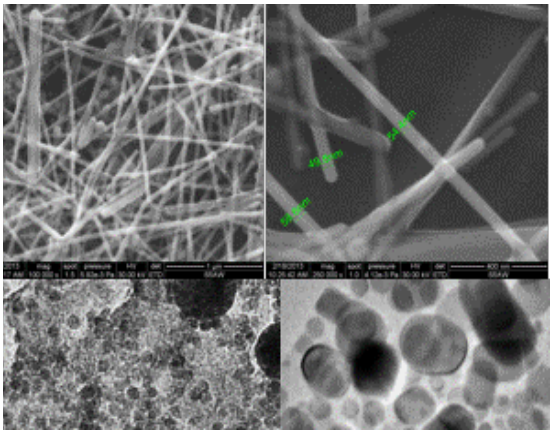
A great challenge in the actual research of solar-to-electricity conversion is the construction of flexible solar cells. Although indium tin oxide (ITO) deposited on plastic is traditionally used for organic solar cells and light emitting diodes, solutions are searched to replace the IT O layer and to manufacture cheap transparent conducting electrodes. Silver nanowires (AgNWs) are a promising candidate to replace ITO due to their high electric conductivity and corrosion resistance, but there is still the issue of increased resistance on wire contacts. The proposed solution involves the modification of the AgNWs by deposition on their surface of metallic nanoparticles with low melting temperatures like tin and indium. The modified nanowires will be suspended in a proper medium to form an electroconductive ink that will be deposited on flexible polymeric sheets. The nanowires will be welded by thermal treatment, with and without the application of static pressure

Project implemented by

Politehnica University Timisoara
Department of Applied Chemistry and Inorganic Compounds and Environmental Engineering

Implementation period

02.09.2013-30.09.2016



Main activities

Research activities:

- Synthesis and characterization of silver nanowires with controlled aspect ratio (2013).
- Synthesis and characterization of indium and tin nanoparticles (2014).
- Development and characterization of transparent conductive electrodes on flexible substrates using silver nanowires and assessment of their electrical and optical properties (2014)
- Synthesis and characterization of silver nanowires modified with tin and indium nanoparticles and preparation of electroconductive inks based on modified Ag nanowires (2015)
- Manufacturing of modified Ag nanowires-based flexible, transparent and conducting electrodes, with high diffuse transmittance and low sheet resistivity by coating the electro-inks on flexible substrates (2015)
- Deposition of a conducting polymer on previously manufactured electrodes and their use in the construction of dye-sensitized solar cells (2016).

Results

- Samples of silver nanowires
- Samples of indium and tin nanoparticles
- Samples of transparent and conductive electrodes

ISI publications:

- R. Banica, D. Ursu, C. Sarvas, S. F. Rus, S. Novaconi, A. Kellenberger, A.V. Racu, T. Nyari, Electrical properties optimization of silver

International conferences

- R. Banica, R. Baies, R. Bucur, C. Locovei, A. Kellenberger, T. Nyari, Study of liquid phase synthesis of silver nanowires for solar cell applications, 3rd European Energy Conference – E2C 2013, October 27-30, 2013 – Budapest, Hungary.
- R. Banica, R. Baies, D. Ursu. M. Poienar, T. Nyari, Silver nanowires synthesis in the PVP-silver-chloride system, ECO IMPULS 2013, November 7-8, Timisoara, Romania.

- R. Banica, C. Sarvas, S.F. Rus, S. Novaconi, A. Kellenberger, T. Nyari, Optimization of the electrical and mechanical properties of transparent electrodes based on silver nanowires supporrted on polyethylene terephtalate, International Symposium on Flexible Organic Electronics ISFOE 14, 7-10 July, 2014 – Thessaloniki, Greece.
- R. Banica, C. Sarvas, S.F. Rus, D. Ursu, S. Novaconi, A. Kellenberger, T. Nyari, Manufacture of ultrathin transparent electrodes based on silver nanowires with application to three-dimensional solar cells, International Symposium on Flexible Organic Electronics ISFOE 14, 7-10 July, 2014 – Thessaloniki, Greece.
- L. Cseh , C. Locovei, O. Marinica, A. Kellenberger, T. Nyari, R. Banica, Synthesis and characterization of indium nanoparticles as precursor for solar cells, New trends and strategies in the chemistry of advanced materials with relevance in biological systems, technique and environmental protection. New trends and strategies in the chemistry of advanced materials, 5-6 June, 2014 – Timisoara, Romania

Applicability and transferability of the results

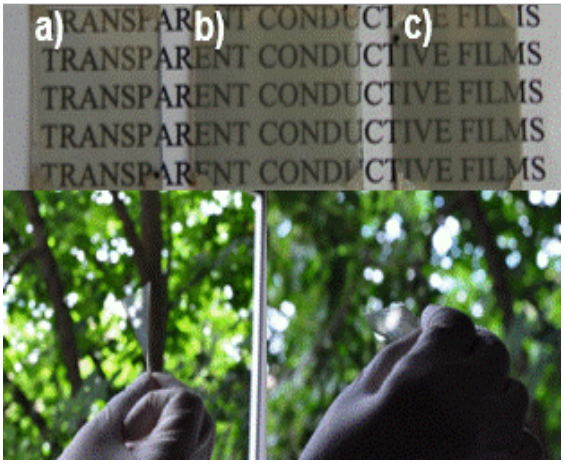
The manufacture of electroconductive inks based on silver nanowires covered with metal nanoparticles with low melting points is expected to have wide technological applications and an important economic impact. This type of conductive inks may be used not only for flexible solar cells but also for other optoelectronic devices, such as flexible LEDs, organic thin film transistors, organic lasers and photo detectors, electronic paper, disposable sensors, low-cost smart cards and RF identification tags, or flexible arrays of plastic microphones.

Financed through/by

UEFISCDI - Executive Agency for Higher Education, Research, Development and Innovation Funding,
Programme IDEAS, Exploratory Research Projects.

Research centre

Research Centre for Environmental Science and Engineering



Research team

Assoc. Prof. Andrea KELLENBERGER, PhD - project manager
Prof. Nicolae VASZILCSIN, PhD – senior researcher
Terezia NYARI - senior researcher
Liliana CSEH - senior researcher
Radu Nicolae BANICA -postdoctoral researcher
Cosmin LOCOVEI - postdoctoral researcher
Radu BAIES- postdoctoral researcher
Mircea Laurentiu DAN - PhD student
Alin BUCUR- PhD student
Daniel Horatiu URSU- PhD student
Paul Cristian CAPOTA - master student

Contact information

Assoc. Prof. Andrea KELLENBERGER, PhD
Department of Applied Chemistry and Inorganic Compounds and Environmental Engineering
Address: Carol Telbisz Street, No. 6, RO300001, Timisoara
Phone: (+40) 256 404 178
Fax (+40) 256 403 060
E-mail: andrea.kellenberger@upt.ro
Web: http://www.chim.upt.ro/Facultatea-de-Chimie-Industriala-si-Ingineria-Mediului_PN-II-ID-PCE-2012-4-0398_qMI.html