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 solarcells. Although indium tin oxide (IT O) 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 IT O 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 or their alloys. The modified nanowires will be suspended in a proper medium to form an electroconductive ink that will be deposited on polymeric sheets. The nanowires will be welded by thermal treatment, with and without the application of static pressure.

Project implemented by

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

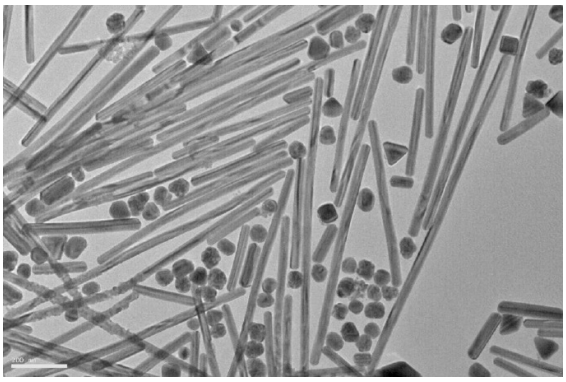
Implementation period

02.09.2013-30.11.2015

Main activities

Research activities:

- Synthesis and characterization of silver nanowires with controlled aspect ratio.
- Synthesis and characterization of tin and indium nanoparticles.
- Preparation of silver nanowires modified with tin and indium nanoparticles (mAgNWs).
- Preparation of electroconductive inks based on mAgNWs.
- Manufacturing of mAgNW-based flexible, transparent and conducting electrodes by coating the ink on polymeric substrate
- Optimization of transparent electrodes in order to increase the transmittance / sheet resistivity ratio.
- Deposition of a conducting polymer on previously manufactured electrodes and their use in the construction of dye-sensitized solar cells.
- Electrical characterization of solar cells (ISC, VOC, fill factor, efficiency).



Results

- Samples of silver nanowires synthesized by the "polyol" liquid phase method.
- Optimization of synthesis conditions to obtain a high ratio of silver nanowires.
- Morphology and structure characterization of silver nanowires by SEM, TEM and XRD

Papers presented at international conferences

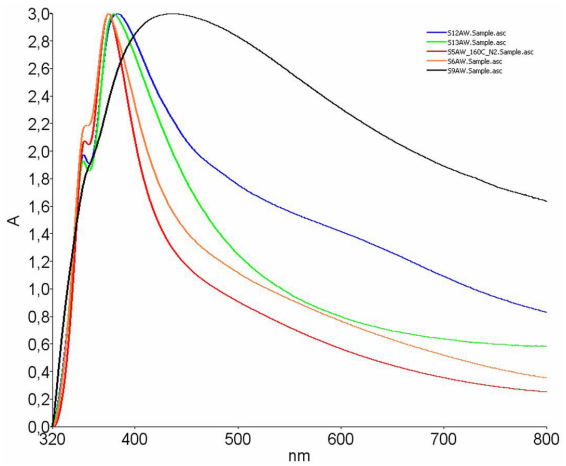
R. Banica, R. Baies, R. Bucur, C. Locovei, A. Kellenberger, T. Nyari, Study of liquid phase synthesis of silver nanowires for solar cell applications, 3rd European Energy Conference – E2C 2013, October 27-30, 2013 – Budapest, Hungary.

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.

Estimated results: 3 scientific papers published in ISI ranked journals, one patent application.

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.

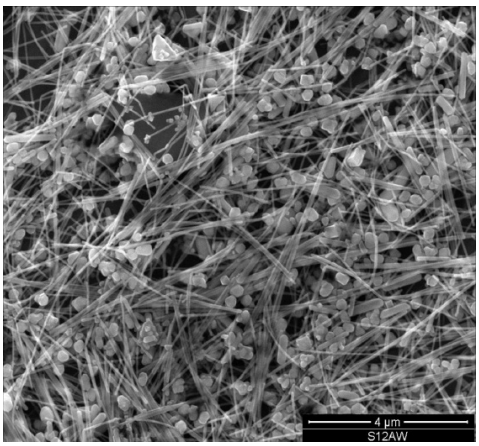


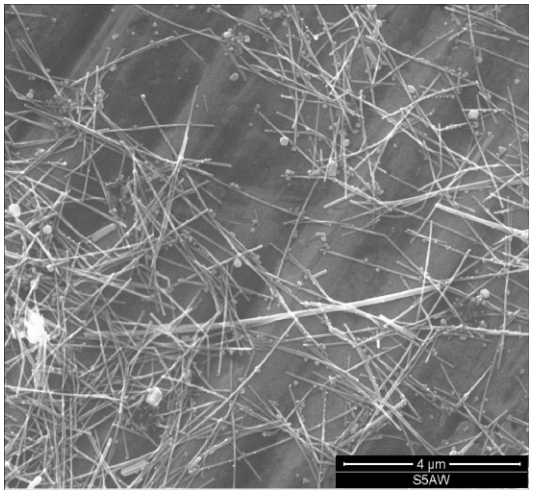
Fields of interest

silver nanowires, flexible solar cell, transparent conductive electrodes.

Research centre

Research Centre for Environmental Science and Engineering





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Research team

Andrea Kellenberger - project manager
Terezia Nyari - senior researcher
Cseh Liliana - 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
Faculty of Industrial Chemistry and Environmental Engineering
Address: Bd. Vasile Pârvan, No. 6, RO300223, 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