NEW FABRICATION CONCEPT OF SILVER NANOWIRE / POLYANILINE 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 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

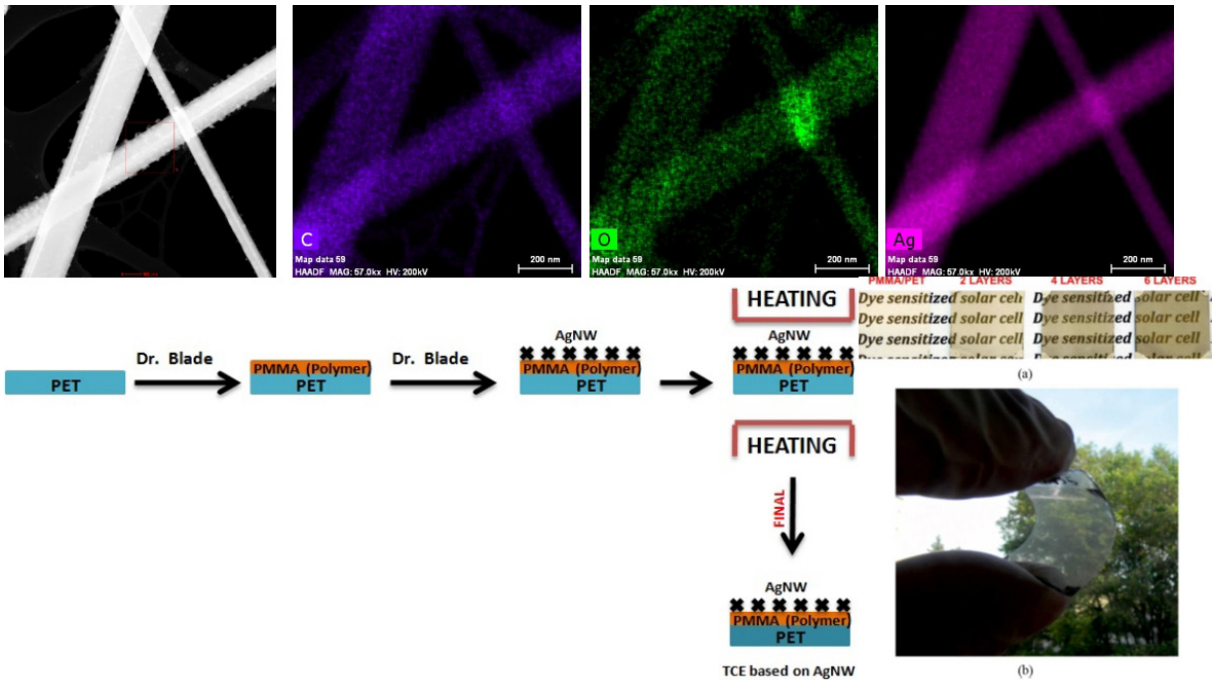
A great challenge in the actual research of solar-to-electricity conversion is the construction of flexible solar cells without using indium tin oxide (ITO). Silver nanowires (AgNWs) are a promising candidate to replace ITO due to their high electric conductivity and corrosion resistance, but there is 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 nanowires were deposited on flexible polymeric substrates to obtain transparent, flexible and conductive electrodes. The sheet resistance of the electrodes was reduced by 35% by hot pressing and by 30% after the deposition of conducting polymers on the silver nanowires.

Project implemented by

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

Implementation period

02.09.2013 - 30.09.2016



Main activities

- Synthesis and characterization of AgNWs with controlled aspect ratio (2013).
- Development and characterization of transparent conductive electrodes on flexible substrates using AgNWs and assessment of their electrical and optical properties (2014)
- Synthesis and characterization of indium and tin nanoparticles (2014)
- Synthesis and characterization of AgNWs modified with tin and indium nanoparticles (2015)
- Preparation of electroconductive inks based on AgNWs (2015)
- Optimization of AgNWs-based flexible, transparent and conducting electrodes to increase diffuse transmittance / resistance ratio (2016)
- Deposition of a conducting polymer on previously manufactured electrodes (2016)
- Construction of dye-sensitized solar cells using AgNWs-based transparent and conducting electrodes (2016)

Results

Patent application

- R. Bănică, A. Kellenberger, D. Ursu, L. Cseh, P. Linul, N. Vaszilcsin, Method for the synthesis of silver nanowires coated with low melting point metal nanoparticles

ISI publications:

- R. Bănică, D. Ursu, T. Nyari, A. Kellenberger, Two step polyol-solvothermal growth of thick silver nanowires, Mat Lett – accepted
- R. Bănică, D. Ursu, T. Nyari, A. Kellenberger, Polyol synthesis of silver nanowires in the presence of silver chloride, Optoelectron Adv Mat – under review
- R. Bănică, D. Ursu, P. Svera, C. Sarvaş, S.F. Rus, S. Novaconi, A. Kellenberger, A.V. Racu, T. Nyari, N. Vaszilcsin, Electrical properties optimization of silver nanowires supported on polyethylene terephtalate, Partic Sci Techn, 34 (2016) 217-222
- D. Ursu, R. Bănică, N. Vaszilcsin, Photovoltaic performance of (Al, Mg)-doped CuCrO2 for p-type dye-senzitized solar cells application, Nanosci Nanotech 6 (2016) 71-76

Applicability and transferability of the results

The manufacture of silver nanowires coated with metal nanoparticles with low melting points is expected to have an important economic impact and is subject of a patent application.
The transparent, flexible and conductive electrodes based on silver nanowires have been successfully tested in dye sensitized solar cells. Conductive inks based on silver nanowires 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 and disposable sensors.

Financed through/by

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

Research centre

Research Centre for Inorganic Materials and Alternative Energies

Research team

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