Vuk V Radmilović et al., J Material Sci Eng 2019, Volume 8
DOI: 10.4172/2169-0022-C1-125

Welded silver nanowires as transparent electrodes in solar cells

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For their ease and cost-effectiveness of synthesis and processing, silver nanowires (AgNWs) have been extensively studied as a transparent electrode alternative to conventional solutions like indium tin oxide (ITO) for the application in optoelectronic devices like solar cells. In this study, AgNWs were synthesized by a simple polyol reduction process. The main focus of this research was elucidating the mechanisms that occur during annealing of AgNWs before a layer of aluminum doped zinc oxide (AZO) is deposited. Microstructural characterization using scanning electron microscopy (SEM) and scanning transmission electron microscopy (STEM) revealed that solid-state wetting and subsequent welding occurred only between nanowires whose contact geometry is characterized by an enormous difference in radii of curvature - the AgNW in contact through a smaller radius of curvature dissolves, Ag atoms diffuse and are incorporated in a welded zone between the AgNWs whose crystallographic orientation is inherent from the AgNW in contact through a large radius of curvature. Tomography was employed to better understand the morphology of the welded zone and geometric relationship between the AgNWs Electron diffraction orientation and strain mapping were performed in order to elucidate possible strain fluctuation across the AgNWs. Crystal lattice distortion, directly measured by atomic column displacements cross-sectional HRSTEM images of demonstrated non-uniform distribution of strain in five twin segments of the AgNW. It has been demonstrated that welding of AgNWs significantly reduces electrical resistivity while preserving high optical transparency, properties essential for transparent electrodes utilized in solar cells. Support from COST MP1407 "e-MINDS" is greatly appreciated.

Biography

Vuk V Radmilović has completed his PhD thesis entitled "Transparent Nanocomposite Films for Plastic Electronic Applications" at the Faculty of Technology and Metallurgy, University of Belgrade. During his PhD studies he was a visiting researcher at Civil and Environmental Engineering Department, University of Perugia, Terni, Italy; Centre des Materiaux, Mines ParisTech, Evry, France and both, at CENEM (Center for Nanoanalysis and Electron Microscopy) and IMEET (Institute Materials for Electronics and Energy Technology), Friedrich Alexander University, Erlangen, Germany. He has been awarded multiple awards and scholarships for scientific mobility from international organizations and has co-authored 19 peer reviewed manuscripts in international journals.

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