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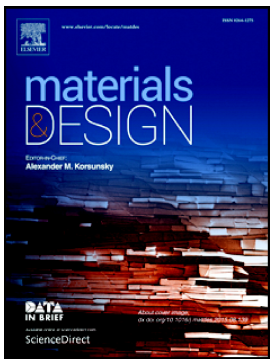

Electrodeposited metal nanowires as transparent conductive electrodes: Their release conditions, electrical conductivity, optical transparency and chemical stability

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Electrodeposited metal nanowires as transparent conductive electrodes: Their release conditions, electrical conductivity, optical transparency and chemical stability

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Abstract

Metal nanowires (MNWs) have gained considerable attention from research groups as they can be effectively applied in new transparent conductive electrodes (TCEs), replacing indium tin oxide (ITO) materials. However, using conventional synthetic methods including the chemical solution, Ag and Cu NW-based TCEs have been found to be non-uniform and unstable in reactive environments. Here, we present an innovative high-throughput method in the fabrication of Ni, AgNi, AgCu and AgNiCu NW-based TCEs using the electrodeposition of metal ions into anodic aluminum oxide (AAO) templates, followed by drop-coating of highly uniform MNWs on glass substrates. After the complete release of 60 μm long MNWs with high crystallinity from the templates, the resulting TCEs show enhanced electrical, optical and chemical stability properties compared to those of ITOs and Ag NW-based TCEs. Notably, in the case of $Ag_{98}Ni_1Cu_1$ NW-based TCEs, we obtain a low sheet resistance of 40 Ω sq^{-1} together with a high transparency of 90%, thereby evidencing the fabrication of high-quality TCEs without byproducts and difficult post-treatments. These MNW-based TCEs are also exposed to sulfurization environment, showing chemical stability with no precedent in the literature.

Keywords: Transparent conductive electrodes, metal nanowires, Ag-based nanowires, electrodeposition, anodic aluminum oxide template, sulfurization environment.

Abbreviations: Transparent conductive electrodes (TCEs); indium tin oxide (ITO); anodic aluminum oxide (AAO); nanowire (NW); metal NWs (MNWs); NaOH concentration (C_{NaOH}); dissolution time (t_d); sheet resistance (R_s); transparency (T); figure of merit (FOM).