NREL Highlights SCIENCE

Nanostructured Transparent Conductors Have Potential for Thin-Film Photovoltaics

Possible alternatives to transparent conductors show promise for enabling new processes and reducing costs.

A critical analysis of the fundamental physics and device performance of nanostructured transparent conductors (TCs) reveals that the optical and electrical properties of metallic nanowire (NW) networks and graphene compare well with traditional transparent conducting oxides (TCOs). This analysis suggests these networks have the potential to impact thin-film photovoltaics (PV).

Networks made of single-walled carbon nanotubes (SWCNTs), metallic NWs, and graphene thin films have all been proposed as replacements for TCOs in PV applications. These networks are solution processable, inherently flexible, and potentially have lower raw material costs (particularly for carbon-based materials). These attributes could be significant advantages in the flexible PV market, where they can enable fully solution-processed devices and novel structures. However, only limited comparisons of nanostructured networks and TCOs are available.

Researchers at the National Renewable Energy Laboratory (NREL) evaluated several common figures of merit used to compare the electrical and optical performance of TCs. The study clearly showed that, even though currently not at the same level of performance as TCOs, metallic NWs and graphene thin films demonstrate a much better combination of transmission and conductivity than SWCNTs and are a promising alternative to TCOs. The promising opto-electronic performance suggests that these materials merit further study as TCs for thin-film PV.

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Reference: Barnes, T.M.; Reese, M.O.; Bergeson, J.D.; Larsen, B.A.; Blackburn, J.L.; Beard, M.C.; Bult, J.; van de Lagemaat, J. (2012). "Comparing the Fundamental Physics and Device Performance of Transparent, Conductive Nanostructured Networks with Conventional Transparent Conducting Oxides." *Advanced Energy Materials* 2 (3), 353-360. DOI: 10.1002/aenm.201100608.

Key Research Results

Achievement

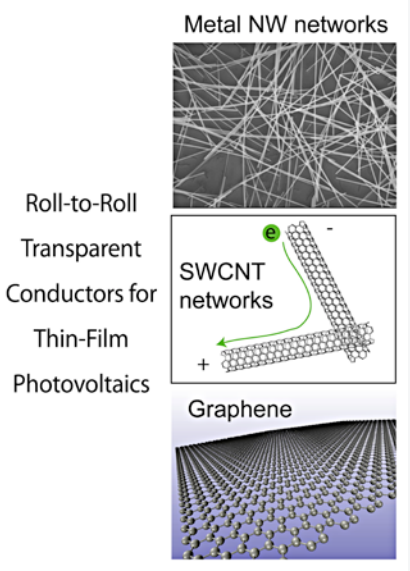
NREL research significantly contributed to inadequate existing data, providing evidence for the potential to replace TCOs with novel materials in applications that require flexibility and solution processing.

Key Result

Metallic NWs and graphene thin films, although not yet at performance levels of TCOs, demonstrate a much better combination of transmission and conductivity than SWCNT networks.

Potential Impact

The attributes of NW networks and graphene thin films—flexible, lower cost, and solution processable—are significant advantages of potential benefit to the flexible PV market.



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