Cation exchanged hybrid semiconductor nanowires for application in photovoltaics

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Abstract: Of late, cation exchange (CE) has emerged as a powerful approach to do post-synthesis chemical modification of pre-synthesized semiconductor nanomaterials. CE also enables to obtain nanomaterials that are otherwise difficult to be obtained by conventional wet chemical synthesis process. CE can also be used to induce complexity in a chemical reaction. A material can be partially or completely exchanged depending on the various reaction conditions. CE at nanoscale is a single step and room temperature process.

Hybrid nanostructures (NS) are obtained by combining two or more NS to form a single unit. Such a NS is capable of exhibiting properties of each component or improvement of particular property of one component due to the other. Metal- semiconductor hybrid nanostructures are of particular interest as they combine plasmonic properties of the metal to the optical properties of the semiconductor. This opens enough avenues to explore novel optical and electrical properties of hybrid NS.

Here, we report on CE of cadmium selenide nanowires (NWs) to convert them to copper selenide ones. Functionalization of these NWs is done by growth of gold domains on their lateral surfaces. CE resulted in metal-like behavior in the NWs. We will present interesting evolution of optical and electrical properties of both bare and hybrid CEed NWs with respect to as-synthesized NWs. We will emphasize on using this new generation of plasmonic nanomaterials for potential application in solar cells and gas sensors.

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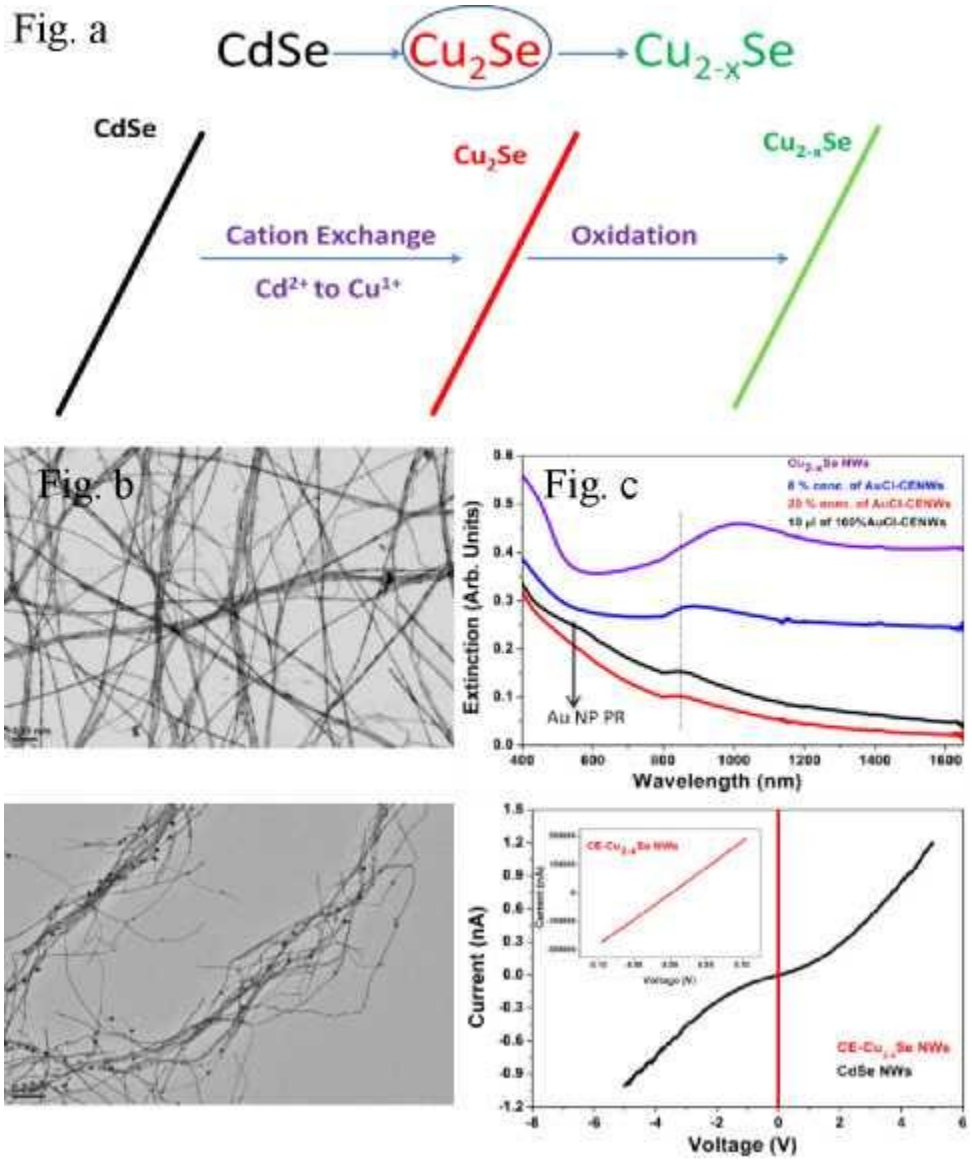

Figure (a): Schematic diagram of the CE process Figure (b): TEM images of bare (top) and gold-decorated (bottom) copper selenide NWs Figure (c): UV-vis absorption spectra (top) of various NWs and I-V plots of bare and CEed NWs.

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