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Review

Nanostructured photoelectrodes for dye-sensitized solar cells

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Summary

Nanotechnology opens a door to tailing materials and creating various nanostructures for use in dye-sensitized solar cells. This review classifies the nanostructures into (1) nanoparticles, which offer large surface area to photoelectrode film for dye-adsorption, (2) coreâ€“shell structures, which are derived from the nanoparticles however with a consideration to reduce charge recombination by forming a coating layer, (3) one-dimensional nanostructures such as nanowires and nanotubes, which provide direct pathways for electron transport much faster than in the nanoparticle films, and (4) three-dimensional nanostructures such as nanotetrapods, branched nanowires or nanotubes, and oxide aggregates, which not only emphasize providing large surface area but also aim at attaining more effective light harvesting and charge transport or collection. The review ends with an outlook proposing that the oxide aggregates are a potentially promising structure which may possibly achieve higher efficiency than the record by reason that the bifunction of aggregates in providing large surface area and generating

reason that the bifunction of aggregates in providing large surface area and generating light scattering allows for photoelectrode film thinner than usual and thus decreases the charge recombination of DSCs.

Graphical abstract

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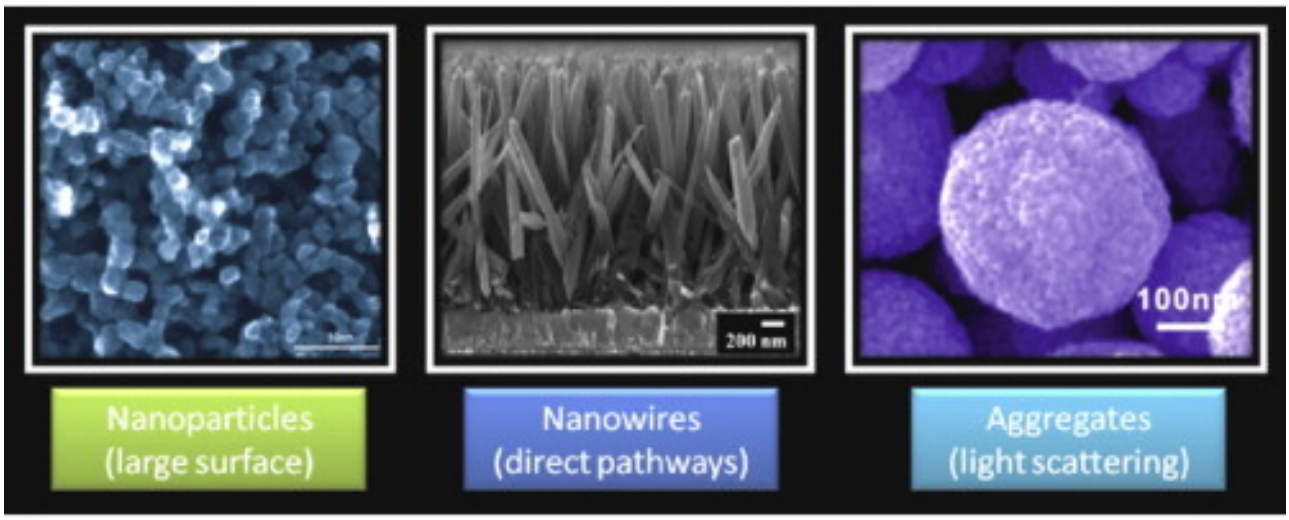

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Research highlights

â–¶ Nanoparticles forming photoelectrode film offer large surface for dye adsorption. â–¶ One-dimensional nanostructures provide direct pathways for electron transport. â–¶ Aggregates of nanoparticles produce both large surface area and light scattering. â–¶ Use of aggregates allow for photoelectrode film thinner than conventional ones. â–¶ Thinner photoelectrode film means shorter electron transport and less recombination.

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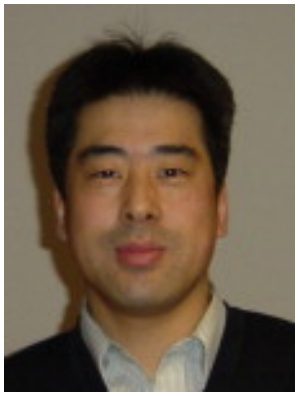
Keywords

Dye-sensitized solar cell; Nanostructure; Nanoparticles; Nanowires; Aggregates; Light scattering



Qifeng Zhang, Ph.D., is currently working at University of Washington as a Research Assistant Professor. His research interests involve engineering applications of nanostructured materials in electronic devices including the solar cells, UV light-emitting diodes (LEDs), field-effect transistors (FETs), and gas sensors.

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