Design and processing of nanostructured energy materials towards sustainable dye-sensitized solar cells

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In recent years, the dye-sensitized solar cell (DSSC), which belongs to the group of emerging solar cells, has been commercialized by several companies mainly towards the use for indoor and IoT sensing applications. The creation of high-performance device components of nanomaterials is one of the crucial issues in order to boost the light-to-electricity conversion efficiency of the devices and even improve their long-term stability. For example, the nano-crystalline titanium dioxide (TiO_2) film with a densely-packed dye layer has been regarded as the best photoanode framework for DSSC among the oxide semiconductors. Particular attention has been paid to the optimization of the structural characteristics of the TiO_2 nanoparticles, which can be tuned by adapting various titanium sources and synthetic methods. Importantly, organic-inorganic nanocomposites consisting of the porous TiO_2 films and conducting polymers offer opportunities for use in a solid-state DSSC. Such a nanocomposite-based device ensures improved stability versus a conventional liquid-electrolyte based DSSC. The design and processing of these nanomaterials, and scope for further development of a sustainable DSSC will be presented.