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Presentation Title:

DESIGN AND SYNTHESIS OF NANO-STRUCTURED TiO_2 FILMS FOR NOVEL APPLICATIONS

Abstract:

Hydrophobic TiO_2 surface

The discovery of a highly hydrophilic TiO_2 surface allowed new functions, such as self-cleaning by rainwater, antifogging effect, energy-saving effect, *etc.* At present, a highly effcient photo-induced hydrophilic TiO_2 which works effectively under weak UV light is required. Conversely, various industrial products also require high hydrophobicity. Since there is a small contact area with water, various phenomena will be inhibited on such highly hydrophobic surfaces, for example, snow adhesion, contamination or oxidation, and frictional resistance. Many other studies have examined either a hydrophilic or hydrophobic surface, but few investigated both. If TiO_2 surface can achieve the high hydrophobicity, the application field of TiO_2 will expand. The wettability of a solid surface is governed by the geometrical surface structure and surface energy. When focusing on the geometrical surface structure, the hydrophilic and hydrophobic properties are enhanced by increasing the surface roughness. Thus, our strategy for both highly effcient photo-induced hydrophilic and highly hydrophilic TiO_2 is to introduce roughness on the TiO_2 surface by a photoelectrochemical etching technique. As shown in Fig. 1, the etched surface underwent highly hydrophilic conversion (CA=0^o) irradiated with weak UV light and near-highly hydrophobic conversion (highest CA=144.3°) stored in the dark, while the non-etched surface only reached CAs of 40^o and 80^o, respectively.

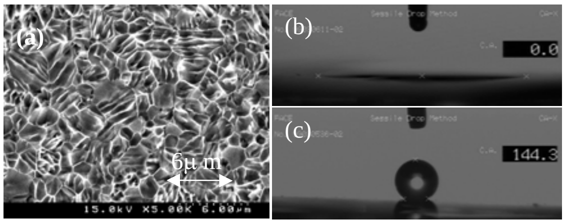

Fig. 1 SEM image of the etched surface (a). Images of water droplet shape on the etched surface after UV irradiation (b) and storing in the dark (c).

Efficient exciton collector for polymer solar cell

For the application of nanostructured polymer solar cells, we have developed a new method to fabricate an array of TiO_2 nanorod assemblies on a flat TiO_2 surface. The TiO_2 nanostructures with height of ca. 40 nm were synthesized via a low temperature sol-gel reaction in a reversed micelle system. Transmission and scanning electron microscopy observation revealed that each nanostructure is an assembly of nanorods with diameter and length of ca. 4 nm and ca. 40 nm, respectively. The formation of the nanorods is selective on TiO_2 surface, suggesting the growth of the nanorods from the seed layer of dip-coated TiO_2. The fabricated array of TiO_2 nanorod was applied to construct photovoltaic devices combined with a semiconducting polymer. Compared to a flat TiO_2 substrate, using the nanostructured TiO_2 substrate has enhanced the photovoltaic performance.

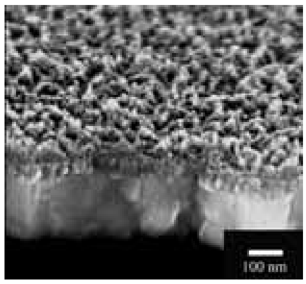

Fig.2 FE-SEM image of the TiO_2 nanostructure.