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Morphology phase diagram of printed titania films derived from block copolymer template assisted a sol-gel technique

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Printing, a simple and low-cost technique for producing films on an industrial scale, is employed to fabricate mesoporous titania thin films. The synthesis is performed by the combination of sol-gel chemistry, in which titanium(IV)isopropoxide (TTIP) is used as precursor and a diblock copolymer polystyrene-block-polyethylene oxide (PS-b-PEO) as the structure-directing template. The amphiphilic block copolymer PS-b-PEO undergoes phase separation and self-assembly due to a good-bad pair solvent, namely 1,4-dioxane and hydrochloric acid (HCl). By adjusting the weight fraction of 1,4-dioxane, HCl and TTIP, the titania films with different morphologies, containing foam-like structure, nanowire aggregates, collapsed vesicles and nanogranules, are obtained after evaporation and calcination processes. The surface morphology of the titania film is probed via scanning electron microscopy (SEM) and optical microscopy (OM), and the inner morphology is detected by grazing incidence small-angle X-ray scattering (GISAXS). The high crystallinity of anatase titania is proved by X-ray diffraction (XRD) and transmission electron microscopy (TEM) upon calcining nanocomposite film at 450 oC in air.

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