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Tunable mesoporous and optoelectronics properties of zinc titanate films using sol-gel technique

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Mesoporous films consisting of zinc titanate have high potential applications in photocatalysis, solar cells, and sensors due to tailoring their semiconductive properties. In the present work, we investigate the morphologies of mesoporous zinc titanate films obtained by changing the ratio of two inorganic precursors after calcining hybrid films consisting of organic-inorganic materials. The amphiphilic diblock copolymer poly(styrene)-b-poly(ethyleneoxide) PS-b-PEO self-assembles into core-shell micelles in a mixture of N,N-dimethylformamid/hydrogen chloride playing the role as structure directing template. The inorganic precursors, zinc acetate dehydrate and titanium tetraisopropoxide, are loaded in the micellar shell due to hydrogen bonds between PEO and precursors. We use slot-die and spin-coating methods to prepare hybrid films, and investigate the influence of the different deposition methods on the film morphologies. Moreover, we investigate how mesoporous structures and crystal phases depend on calcination temperature, concentration and the ratio of two precursors. The morphologies of the hybrid films are characterized using grazing incidence small-angle X-ray scattering (GISAXS) and scanning electronic microscopy (SEM). The film thickness, crystal phase, chemical composition and optical properties are characterized using X-ray reflectivity, X-ray diffraction, Fourier transform infrared spectroscopy, and ultraviolet-visible spectroscopy, respectively.

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