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Characterization of Mesoporous Zinc Titanate Hybrid Films Using Grazing Incidence Small-angle X-ray Scattering

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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. This study investigates 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(ethylene oxide) PS-b-PEO self-assembles into core-shell micelles in a mixture of N, N-dimethylformamide/hydrochloric acid playing the role of a structure-directing template. The inorganic precursors, zinc acetate dihydrate and titanium isopropoxide 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 were characterized using grazing incidence small-angle X-ray scattering (GISAXS) and scanning electron microscopy (SEM) and the obtained data will be used as training data for machine learning approaches.

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