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Highly ordered titania films with incorporated germanium nanocrystals annealed in different atmospheres for photoanodes

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Mesoporous titania films with ordered nanostructures show great promise in various applications, e.g. solar cells. To optimize solar cell performance, pre-synthesized crystalline germanium (Ge) nanocrystals around 10 nm are introduced into mesoporous titania films. The influence of different annealing atmosphere (air and argon) on the morphology and properties of the titania/Ge composite films is studied. Resulting surface and inner morphology changes are investigated by scanning electron microscopy and grazing incidence small-angle X-ray scattering (GISAXS), respectively. Elemental composition of the titania/Ge composite films annealed in air and argon atmosphere is compared via X-ray photoelectron spectroscopy. The crystalline and optical properties are observed by X-ray diffraction, transmission electron microscopy and ultraviolet–visible spectroscopy, respectively. Through the incorporation of germanium nanoparticles with varied weight percent and annealing under different atmospheres, the optimized morphology and properties of titania/Ge composite films will be obtained, providing a promising candidate for solar cell photoanodes.

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