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## In situ study of morphology evolution of block copolymer templated metal oxide films

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Scalable production of the thin film is interesting for the commercialization of these materials. A fundamental understanding of the structure evolution during deposition is of great importance to tailoring the mesostructures. In a diblock copolymer-assisted sol-gel chemistry method, hybrid films of metallic species and polymer are formed with slot die coating. Pure block copolymers are deposited as control. In situ grazing-incidence small-angle X-ray scattering measurements are performed to investigate the self-assembly and co-assembly process during the film formation. A face-centered cubic (FCC) structure is preferentially formed in the hybrid film with improved order compared to the pure block copolymer thin films. A superlattice-like mesoporous metal oxide film is obtained by removing the polymer template from the hybrid films. The large data set of in situ GISAXS data will be used for machine learning applications.

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