

Thin film photodeposition in Ti-alkoxides

J.D. Musgraves, Z. Schneider, K. Simmons-Potter, B.G. Potter, Jr., T.J. Boyle

Photosensitive, Ti-alkoxide precursors, possessing bulky ligand groups with enhanced stability against conventional hydrolysis and condensation, have been used to demonstrate the photoinduced formation of partially condensed, oxide-containing thin film materials directly from dilute solution and from spin-coated precursor films. Ultraviolet irradiation of hydrous-pyridine solutions of $(\text{OPy})_2\text{Ti}(\text{TAP})_2$ (where $\text{OPy} = \text{OC}_6\text{H}_6\text{N}$ and $\text{TAP} = \text{OC}_6\text{H}_2(\text{CH}_2\text{N}(\text{CH}_3)_2)_3$), at photon energies resonant with $\pi\text{-}\pi^*$ transitions of the cyclic ligands present in this alkoxide precursor, have resulted in the preferential disruption of the TAP group and the initiation of hydrolysis and condensation. Electron microscopy of photodeposited films formed from solution reveals a nanoporous material whose microstructure can be altered through control of solution water content as well as irradiation conditions. Irradiation of solid-state precursor films also results in an insoluble thin film phase with a vibrational structure similar to that of the solution-derived, photodeposited material. Through patterned photoexposure in either case, the direct fabrication of microscale physical relief structures have been demonstrated, thus indicating the potential of this deposition technique to simultaneously tailor both nano- and microscale film structure by combining chemical and optical process controls.