PULSED AND CONTINUOUS PLASMA TREATMENTS OF MESOPOROUS TITANIA FOR PHOTOVOLTAICS

Daniel J. V. Pulsipher, Ellen R. Fisher
Department of Chemistry, Colorado State University Fort Collins, CO 80523

Mesoporous films formed from TiO_2 nanoparticles are intriguing candidates for modification due to their importance in environmental concerns of energy and pollution. Adding surface functionalization to remove electron trap states and/or creating a surface passivation layer will improve photovoltaic TiO_2 devices.[1] Alternatively, adding surface trap states could improve photocatalytic devices.[2] Pulsed plasma processes provide benefits of lower power and temperature processing, and they add additional control over the implanted species compared to continuous wave plasmas.[3] In this work, low temperature inductively coupled rf oxygen plasmas are used to modify the surfaces of mesoporous TiO_2 films. Plasma pulsing is implemented and lower pulse duty cycles are examined to reveal a reduction and elimination of Si incorporation into the mesoporous films. Carbon percentages of all films are reduced after O_2 plasma treatment. Implanted species and their chemical environments are characterized by X-ray photoelectron spectroscopy; film morphology is revealed via SEM and AFM. Plasma modified and unmodified TiO_2 materials have been tested in dye sensitized solar cells and results from these studies will be presented along with additional results from other plasma treatments.

[1] Kopidakis, N.; Neale, N. R.; Frank, A. J. *J. Phys. Chem. B* **2006**, *110*, 12485.
[2] Ihara, T.; Miyoshi, M.; Ando, M.; Sugihara, S.; Iriyama, Y. *J. Mater. Sci.* **2001**, *36*, 4201.
[3] Malkov, G. S.; Martin, I. T.; Schwisow, W. B.; Chandler, J. P.; Wickes, B. T.; Gamble, L. J.; Castner, D. G.; Fisher, E. R. *Plasma Process. Polym.* **2008**, *5*, 129.