Materials Science & Engineering Master's Defense

Electron Microscopy Study of Phase Transformation and Metal Functionalization of TiO_2 Nanotubes

School for Engineering of Matter, Transport and Energy

Sanjitarani Santra

Advisor: Peter A Crozier

abstract

Titanium oxide (TiO_2), an abundant material with photocatalytic activity and chemical stability is an important candidate for photocatalytic applications. The photocatalytic activity of the TiO_2 varies with its phase. In the current project, phase and morphology changes in TiO_2 nanotubes were studied using *ex-situ* and *in-situ* transmission electron microscopy (TEM). X-ray diffraction and scanning electron microscopy studies were also performed to understand the phase and morphology of the nanotubes. As prepared TiO_2 nanotubes supported on Ti metal substrate were amorphous, during the heat treatment in the ex-situ furnace nanotubes transform to anatase at 450 °C and transformed to rutile when heated to 800 °C. TiO_2 nanotubes that were heat treated in an *in-situ* environmental TEM, transformed to anatase at 400 °C and remain anatase even up to 800 °C. In both ex-situ an in-situ case, the morphology of the nanotubes drastically changed from a continuous tubular structure to aggregates of individual nanoparticles. The difference between the *ex-situ* an *in-situ* treatments and their effect on the phase transformation is discussed. Metal doping is one of the effective ways to improve the photocatalytic performance. Several approaches were performed to get metal loading on to the TiO_2 nanotubes. Mono-dispersed platinum nanoparticles were deposited on the TiO_2 nanopowder and nanotubes using photoreduction method. Photo reduction for Ag and Pt bimetallic nanoparticles were also performed on the TiO_2 powders.

April 17, 2014; 11:00 AM; ISTB4 596