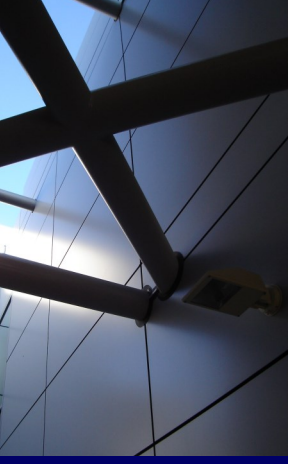

MECHANICAL ENGINEERING

The Department of Mechanical Engineering presents:

The Master's Dissertation Defense of:

Duncan Ashby

Monday, August 24, 2015
2PM, Bourns Hall A265

One-Step Fabrication of Photocatalytic Nanoporous Titania for Efficient Water Treatment

Master of Science, Graduate Program in Mechanical Engineering
University of California, Riverside, June 2015
Dr. Masaru Rao, Chairperson

Titanium dioxide has been shown to degrade organic contaminants in water through photocatalysis. While current research focuses on maximizing degradation efficiency, a need exists to further investigate the oxidation properties of titania as a means to tailor this material for integration into a high-throughput device. Herein we present a nanoporous titania (NPT) exhibiting good degradation efficiency as groundwork for a microfluidic reactor. Using hydrogen peroxide (H2O2) oxidation of titanium substrates, we were able to grow a high surface area nanoporous film with good structural integrity, and little to no signs of delamination. A growth parameter study was conducted to determine the optimal oxidation conditions for photocatalytic activity. Characterization of the material was carried out with XRD and SEM to record the effects of H2O2 concentration, temperature, and time on the morphology and crystallinity of the NPT. In order to establish a standard, we used BET analysis to calculate a surface area of Degussa P25 comparable to our NPT 1x1 in2 chip. Photocatalytic response was measured and compared to P25 drop-casted films via degradation of methylene blue. Over the course of three hours, we observed a 56.13% and a 76.16% degradation of methylene blue from our NPT and P25 samples, respectively. The degradation of methylene blue was found to be a first order reaction with the two materials demonstrating reaction rate constants of 0.0045 (NPT) and 0.0081 (P25) mg/L min-1. The studies conducted show that NPT is an efficient photocatalyst with good structural integrity to suit applications in microfluidic reactors.