PhD Candidate Profile

Name:
Ciara Byrne

Research Group:
Nanotechnology Research Group

Research Centre:
The Centre for Precision Engineering, Materials & Manufacturing research (The PEM Centre)

Department/School:
Department of Environmental Science, School of Science

College:
Institute of Technology Sligo, Ash Lane, Co. Sligo, Ireland

Supervisor:
Prof. Suresh Pillai

Funding body:
IT Sligo President's Bursary

Area (field) of study:
Titanium dioxide photocatalysis

Thesis Title:
Understanding the Mechanism of Anatase to Rutile Transition in Titania Photocatalysis

Abstract:
Titanium dioxide is one the most researched photocatalyst as it is nontoxic, the ease of preparation, its strong oxidising ability, availability and its long-term stability. Titanium dioxide (titania) has three main crystalline phases, anatase (tetragonal, a=b=3.78Å; c=9.50Å), brookite (rhombohedral, a=5.43Å; b=9.16Å; c=5.13Å) and rutile (tetragonal, a=b=4.58Å; c=2.95Å). Rutile has been reported as the most thermodynamically stable phase and is the phase most abundantly found in nature. Anatase and brookite are both metastable phases, they irreversibly transform into rutile at temperatures between 600-700°C in pure synthetic titanium dioxide. Of the three phases, anatase is considered to be the most photocatalytic active phase. Different chemical additives/dopants can be used to extend the anatase to rutile phase transition to higher temperatures. The ability to make high temperature (≥800°C) stable anatase phase with photocatalytic properties is required for some its applications.

PhD Candidate Profile

The main objectives of this work are:

- The chemical synthesis (sol-gel and microwave assisted synthesis) of titanium dioxide nanomaterials with a number of different precursors (e.g. titanium isopropoxide or titanium butoxide).
- Calcining all samples at temperatures between 400-1100°C for the purpose of determining the temperature the anatase to rutile occurs at.
- To add a number of different chemical additives/dopants in varying concentration and examine how this affects the transition from anatase into rutile.
- To examine how the above factors affect the photocatalytic activity of titanium dioxide.
- To use titanium dioxide as a photocatalyst for environmental applications, e.g. for water treatment.
- The samples will be characterized by X-Ray Diffraction (XRD), Field Emission Scanning Electron Microscopy (FESEM), Transmission Electron Microscopy (TEM), X-ray Photoelectron Spectroscopy (XPS), Fourier Transform Infrared Spectroscopy (FTIR), Raman spectroscopy and gas phase photocatalysis studies.

Collaborations:

- University of Surrey
- Dublin Institute of Technology

Publications:

N/A

Presentations:

The 25th Irish Environmental Researcher's Colloquium (ENVIRON) in Nanotechnology (April 2015)