

## Department of Physics &amp; Astronomy

Dr. Peter Crozier

*School for Engineering of Matter Transport and Energy**Arizona State University, Tempe, AZ 85287, USA*

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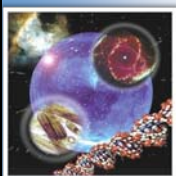
3:15 p.m. - 4:15 p.m.

BB 3.04.18\*

**Evolution and Functionalities of Energy Related Nanomaterials**

Catalytically active nanomaterials play a critically important role in modern technology significantly impacting areas in energy including fuel processing, fuel cells and solar fuels. Heterogeneous catalysis relies on the unique ability of highly dispersed forms of material to direct chemical transformations. However, the “active form” of the material may exist only in the unique environment inside a reactor where additional changes in the nanostructure of the catalyst such as phase transformations, shape changes and surface reconstructions may take place. Consequently there is increasing emphasis on developing in situ characterization methods because only these techniques can probe the catalytic material under reactive gas conditions providing information that may not be obtained from ex situ methods.

We are using in situ environmental transmission electron microscopy (ETEM) to study fundamental questions associated with the synthesis and evolution of catalytic nanomaterials under reactive gas conditions. In the modern ETEM, the powerful combination of atomic resolution imaging and nanospectroscopy provides dynamic information on both the structural and compositional transformations taking place under reactive gas conditions. This presentation will focus on the application of ETEM to the supported metal and oxide systems. Differences (such as pressure, mass transport, catalysts loading, conversion etc...) may exist between the ETEM reactor and the reactors typically employed to determine catalytic properties. These considerations are discussed and illustrated on supported Ni and NiRu catalysts for partial oxidation of methane where we correlate ETEM observations with reactor data to give a detailed description of the catalyst evolution during activation. Applications to doped ceria solid oxide fuel cell anodes and titania-based photocatalysts are also described.

**Department Contact Information**

Dr. Marcelo Marucho • 210.458.7862 • Marcelo.Marucho@utsa.edu

Nakia Scott • 210.458.5698 • Nakia.Scott@utsa.edu

<http://physics.utsa.edu/>**\*Please DO NOT enter this room prior to 3:00pm. Doing so will disrupt another class.**