Title:	Pd Nanoclusters Supported on MgO(100): Effects of Cluster Size on Chemisorption Properties
Type:	Student
Awardee:	Steven Tait
Mentors:	Charles Campbell – UW; Samuel Fain – UW; Zdenek Dohnalek – PNNL; Bruce Kay - PNNL
Description:	Low-temperature methane combustion for applications in electric generator turbines is catalyzed by Pd nanoparticles to minimize NOx pollution. The reaction depends on the dissociation of methane molecules on the Pd surface. Nanoscale Pd particles contain coordinatively unsaturated Pd atoms which may facilitate the dissociation of CH4, thereby making this process more facile. Little is known about how metal particle size affects dissociation of small hydrocarbons, in spite of its obvious importance in a variety of catalytic processes. We propose to study particle size effects on the adsorption and dissociation of methane, ethane, and propane on model catalysts consisting of size-controlled Pd nanoclusters supported on MgO(100). The reactions will be studied by molecular beams and temperature programmed desorption at low temperatures, a regime little explored for such well-defined model catalysts. MgO(100) thin films will be grown on a Mo(100) substrate. Pd will be vapor deposited at low temperatures and annealed to form Pd nanoparticles. The organic molecules will be deposited with a cold molecular beam to prevent direct dissociation upon impact, or at higher energies to open up direct dissociation. To complete the analysis of these sticking measurements on Pd Particles, we will measure dissociation of the molecules on Pd(111) as a function of incident angle. Complementary non-contact atomic forcemicroscopy (NC-AFM) measurements using C nanotube tips will yield information about the morphology and number density of the Pd nanoclusters as a function of deposition temperature and coverage. Together these measurements will allow a greater understanding of the catalytic activity of this important combustion catalyst, and particle size effects in hydrocarbon catalysis in general.