From: **Benjamin Bein** benjamin.bein@stonybrook.edu
Subject: Update: Dissertation Announcement
Date: April 8, 2016 at 14:37
To: Jacobus Verbaarschot jacobus.verbaarschot@stonybrook.edu, Donald Sheehan donald.j.sheehan@stonybrook.edu

BB

hello Jac and Donald,

I just noticed a typo on my announcement the Room number was Physics B-133 but the correct number is Physics B-131.
I attached a corrected version of the file.

Thank you for your help!

Best,
Benjamin

Stony Brook University
The Graduate School

Doctoral Defense Announcement

Abstract

In-situ x-ray diffraction, atomic force microscopy and photo catalytic characterization of ferroelectric perovskite surfaces

By

Benjamin Bein

Producing storable renewable energy is one of the greatest technological challenges today. Photocatalytic water splitting to produce hydrogen is one possible way to produce storable renewable energy. The photocatalyzed reaction of silver from silver-nitrate solution is a suitable proxy reaction for water splitting and the evolution of O_2. For these photocatalytic reactions the surface of the catalyst is of tremendous importance. Therefore site specific photocatalytic deposition of silver nanoparticles, from silver-nitrate solution, on well-defined $SrTiO_3$ surfaces was studied. By performing these experiments on well-defined surfaces we found that silver nanoparticles formed predominantly at the boundary between surface termination changes.

Atomically flat $SrTiO_3$ crystals can not only be used to study photochemistry, but also as substrates for the heteroepitaxial growth of heterostructures. The heterostructures are composed of ultra-thin layers of different perovskite oxides, some of which have important functional properties, such as ferroelectricity. By stacking different perovskites on top of one another we can introduce new properties from one material to another. For example paraelectric $SrTiO_3$ can become ferroelectric on top of a $PbTiO_3$ film. The study of heterostructures allows us to decouple the influence of surface structure from the influence of ferroelectricity.

Polarization domain structure has a strong influence on the photocatalytic reactivity of ferroelectric surfaces, and, as this structure is largely determined during the growth of the material, it is extremely interesting to investigate the evolution of ferroelectric properties during the growth of an oxide heterostructure. In-situ x-ray diffraction is an ideal method for this. We used it to monitor ferroelectric domains, surface termination, average lattice parameter and bilayer thickness, simultaneously during the growth of ferroelectric ($BaTiO_3/SrTiO_3$) superlattices on $SrTiO_3$ substrates by off-axis RF magnetron sputtering. A technique we developed allows for scan times substantially faster than the growth of a single layer of material, greatly expanding the scope of this kind of experiment. Effects of electric boundary conditions were investigated by growing the same superlattice alternatively on $SrTiO_3$ substrates and 20nm $SrRuO_3$ thin films on $SrTiO_3$ substrates. These experiments provide important insights into the formation and evolution of ferroelectric domains when the sample is ferroelectric during the growth process.

Date: 05/06, 2016 **Program: Physics**

Date: 05/06, 2016
Time: 9:30am
Place: Physics B-131

Program: Physics
Dissertation Advisor: Matthew Dawber