BUENAVENTURA AEROSPACE SOCIETY CHAPTER

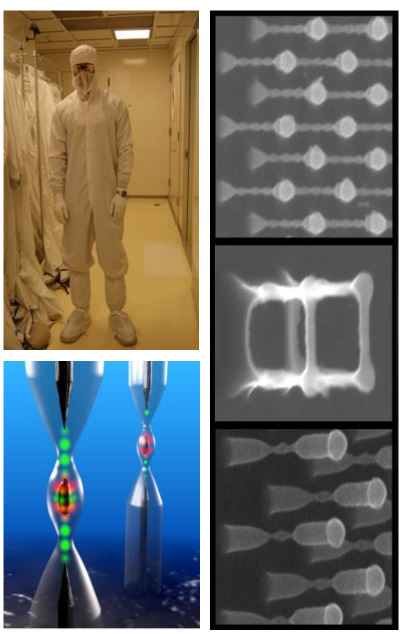
The view from the “bottom”

The state of the art in nanotechnology research,
Its historical evolution, and possible future directions

Sameer Walavalkar, PhD

Thursday September 17, 2015 at 6:30 pm

California Lutheran Overton Hall, 3163 Regent Ave, Thousand Oaks, CA
Meetings are free and open to the public
Register at this website



While the term “nanotechnology” still conjures up exotic science, incomprehensible physics, and engineers swaddled in sterile “bunny suits,” the truth is that it has become ubiquitous in the world around us. Beyond cramming more and more transistors onto silicon chips, the past 10-15 years has seen an explosion of products utilizing nanofabrication in unexpected applications, including: acne treatment, wrinkle-free pants, fuel additives, food additives, and detergents. This huge breadth of applications is a reflection of a claim once made by Richard Feynman in a talk titled “There’s plenty of room at the bottom.” While Professor Feynman left the definition of “the bottom” vague, most of the speculative goals he proposed have been met and surpassed; so the question now becomes: Are we running out of room at the bottom? As a relatively recent PhD. graduate in this field, Dr. Walavalkar has had both a front row seat to these new developments and a hand in expanding the ultimate limits of nanofabrication to unlock and apply the novel behavior of materials at the nanoscale.

This talk will cover the history of nanoscience (starting at its roots in the microelectronics industry), the current capabilities and limitations of an academic fabrication facility (as seen through the sequential fabrication of a new silicon nano-device), some of the new and unexpected physics seen when materials are shrunk to the nanometer scale and conclude with the current research and exciting future applications based on the nanoscience work being carried out at Caltech’s Kavli Nanoscience Institute. Along the way we will cover several key concepts central to current research into and new applications of nanotechnology (such as serial vs. parallel fabrication, bottom-up vs. top-down methods, manufacturability, sensor applications, and the infamous gate leakage problem).

Dr. Sameer Walavalkar is a currently a joint post-doctoral scholar/research scientist, splitting his time between Caltech's Kavli Nanoscience Institute (KNI) and USC's Translational Imaging Center where he works with Professor Scott Fraser. He received a B.S. in Electrical Engineering from the University of Michigan and an M.S. and PhD. in Applied Physics from Caltech, graduating in 2011. His thesis, titled "Optical, mechanical and electronic properties of etched silicon nanopillars" was completed under the guidance of Professor Axel Scherer. His prior work has focused on inventing new mass-manufacturable fabrication methods to access and study the physics of previously impossible devices, sizes and geometries. He pioneered the development of several "hybrid" top-down/bottom-up fabrication techniques that could create uniform arrays of structures at the wafer scale with dimensions in the 1-2nm range. He was also the first to demonstrate the controlled, top-down, three-dimensional plasma sculpting of silicon with 5nm features; which opened the field of "geometric bandgap engineering" in which the electronic bandstructure of silicon could be manipulated through geometry alone. Many of these new methods have been widely adopted, most notably the KNI fabrication facility at Caltech has made the "symbiotic" alumina mask and "pseudo-Bosch" plasma etch the default nanoscale silicon etching recipe.

Dr. Walavalkar's current work is focused on exploiting plasmonic, light-metal interactions using nanoscale geometries to massively improve the efficiency of Raman spectroscopy for a variety of applications. Some of these have included: tracking single protein binding in real time, quantifying the concentration of an entire cancer marker panel in complex media (such as saliva or blood) in a single measurement, continuous, in-vivo, intra-venous monitoring of thrombin in the circulating blood of a patient on blood thinners, and the remote detection of a variety of chemicals for large scale applications (soil nitrogen content of an entire farm) or for hazardous/inaccessible applications (hydrogen sulfide concentrations at the bottom of oil wells during drilling operations) .

Location: California Lutheran University
Overton Hall,
3163 Regent Ave, Thousand Oaks
(see map on next page)
Pizza/networking starts at 6:30 pm
Talk starts at 7:00 pm

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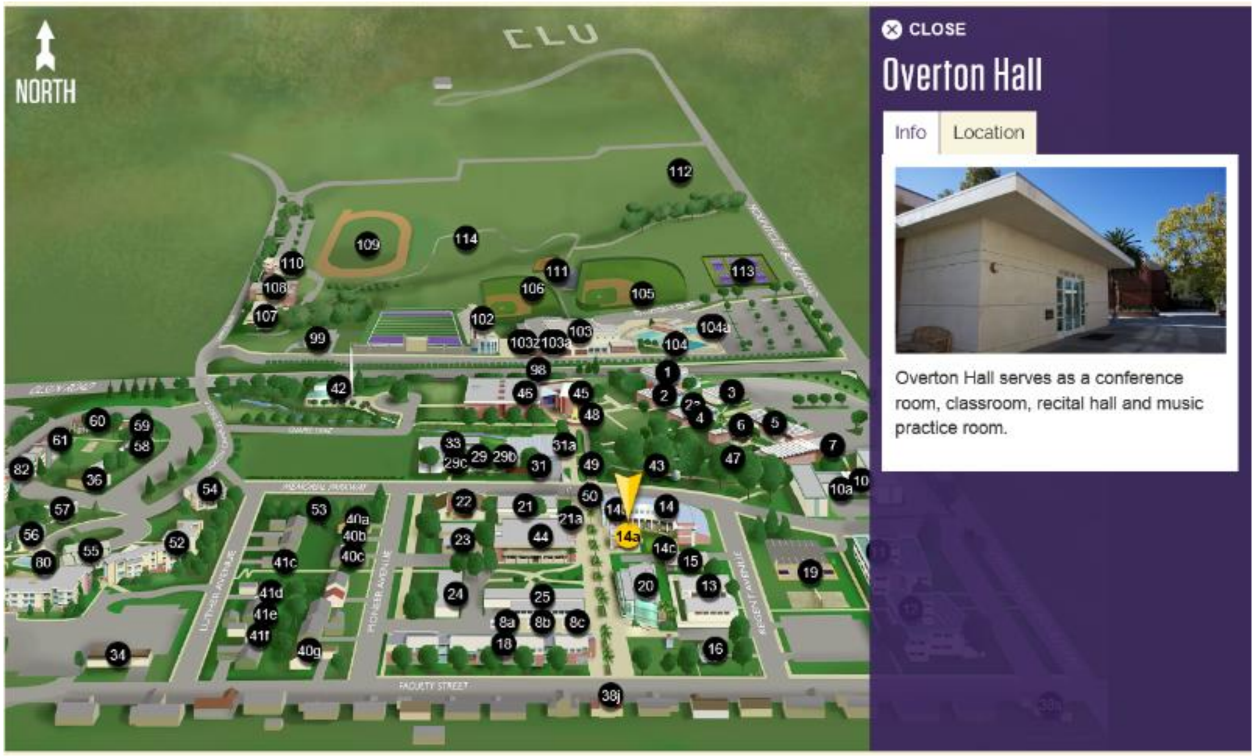

Directions from Ventura:
Take the Ventura Freeway 101 South.
Take Lynn Road Exit, turn left, drive 2.9 miles.
Lynn Road turns into Olsen Road, drive .9 miles.
Turn right onto Mountclef Boulevard - the University is on the right

Before 7 pm, we recommend to park in the G lot on the southwest corner of Olsen and MountClef and walk to the Overton Hall. You do not need a permit to park in the G lot. Visitors may park on the streets after 7 pm without a permit. Important: watch the reserved parking signs and do not park in them.

Directions from Los Angeles:
Take the Ventura Freeway 101 North.
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Lynn Road turns into Olsen Road, drive .9 miles.
Turn right onto Mountclef Boulevard - the University is on the right.

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