Thin Films, Deep Learning

Cadets Hit the Physics Lab for Independent Research Projects

By Mary Price

Four 1st class physics majors got a taste of life as working scientists this past fall when they wrote a grant proposal, received the funds necessary to buy their supplies, and carried out experiments in the thin films lab. What's more, one of the cadets, Ching-Hung Tseng '15, is now pursuing an independent study based on his work in the fall.

Because the cadets had done only general lab work for required classes, Lt. Col. Daniela Topasna, associate professor of physics and astronomy, designed this year's capstone to include work in the thin films lab, where she does her own research.

Under Topasna's guidance, the cadets learned the ionic self-assembled multilayers (ISAM) technique of thin films creation.

Topasna explained that thin films are coatings used for a variety of surfaces, including scratch-resistant lenses and corrosion-resistant coatings. The thickness of a thin film is measured in nanometers. A nanometer is one billionth of a meter.

"You end up with layers of cake, almost, but you do it one layer at a time," Topasna said of the process of creating thin films.

But before the cadets could get under way in the lab, they needed materials, including lab coats and gloves so the dyes they'd be using wouldn't stain their uniforms. Topasna thus coached the cadets through the process of writing an application for a $300 Wetmore Fund grant through the VMI Center for Undergraduate Research.

"Having four students, I wanted each one to be hands-on with a set of materials," she explained. "I thought it would be a good experience for them to work together as a team and write the proposal."

Tseng's project complements a Summer Undergraduate Research Institute initiative undertaken by Cadet Hunter Liu '15 last year in preparation for writing an honors thesis this year.

Liu's project was to create an optical pH sensor using the ISAM technique, with the goal of producing an instrument that could be used in the biomedical field.

"For medical purposes, the pH sensor is based on voltage change; … it's not biocompatible, and it's very big," said Liu. The model he attempted to create would be much smaller, and nontoxic to the body.

By the end of the summer, Liu had produced a sensor that would work, although only in a narrow pH range. In the fall, Liu took a break from the project to study abroad at the Japanese National Defense Academy.

Now he's back in the lab, where he's working on finding the optimum number of film layers for his sensor.

"If you make too thick of a film, only the few top layers respond to the pH changes, and the layers closer to the substrate are not affected," explained Topasna.

This semester, Tseng is working to find out how temperature and time affect the sensitivity of the films in Liu's sensor.

"I just think it's interesting that you can transfer this material to a substrate," said Tseng. "It's really useful in a real-world application."

A native of Taiwan, Tseng came to VMI with a strong interest in physics that he'd picked up while in high school.

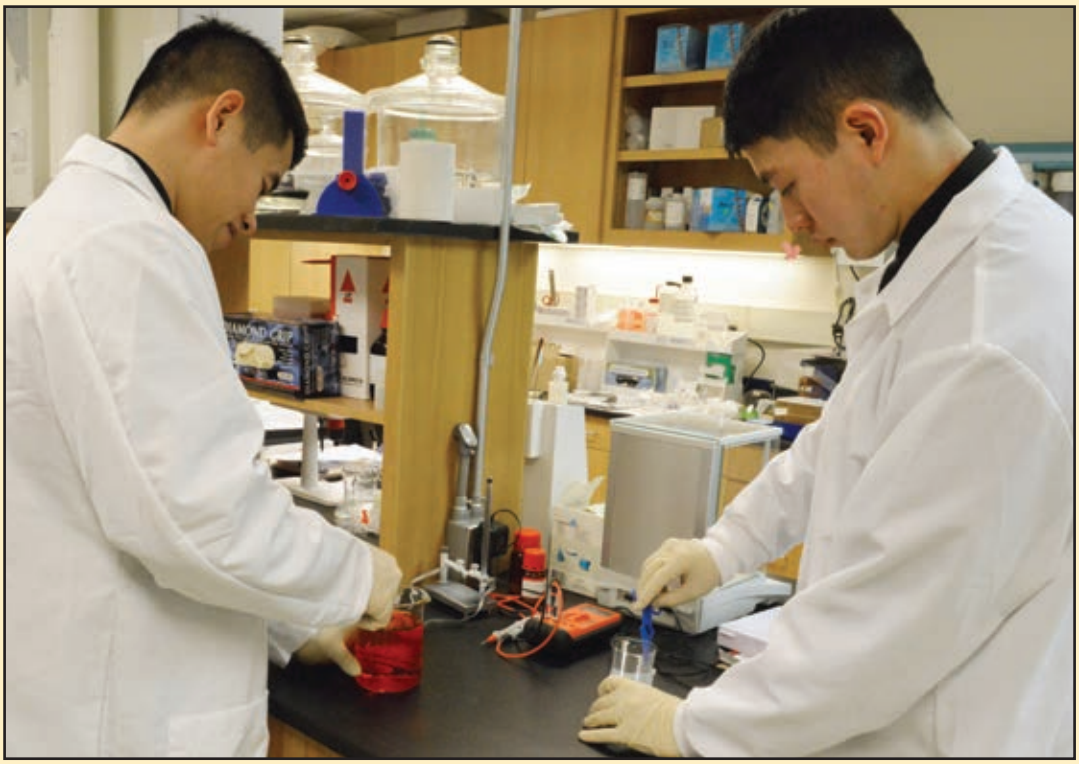
"I'm just really fascinated about what Albert Einstein did in the field of relativity," said Tseng. "That inspires me."

Said Topasna of Tseng, "He has a very inquisitive mind. I like how he poses questions. … When you get the right question, that makes you think a little bit more and explain it a bit more."

The other cadets enrolled in the capstone course in the fall all had the chance to select and carry out their own projects in the thin films lab.

Cadet Alex Falten '15 also worked on a pH sensing project, while Cadet Nick Mahin '15 worked with a copper phthalocyanine-based material that's used in photo-voltaic applications such as solar cells. Cadet Dylan Bolden '15 researched cerium oxide antibacterial films, which could someday be used to inhibit pancreatic cancer

Topasna also noted that this year nine cadets are expected to graduate with the physics major, the largest number since she began teaching at VMI in 2002.



Ching-Hung Tseng '15 (left) and Hunter Liu '15 work on projects in the thin films lab. – VMI Photo by Kelly Nye.