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ALUMNI SPOTLIGHT

US Air Force Active Duty Officer Graduates from UMD Physics

This past summer, Anthony Franz, packed his things in preparation for a big move. Unlike most graduate students, Franz had a job waiting for him after completion; teaching physics courses at the US Air Force Academy. The department teaches two core physics classes to all students. Other courses are offered for physics majors. Currently, Franz is an active duty officer in the Air Force with a rank of major. Last fall he was selected for Lieutenant Colonel and should advance to rank shortly. He will be working in the Lasers and Optics Research Center and will also provide service to the department in an administrative position yet to be determined.

“I enjoy my career,” said Franz. “It has given me the opportunity to travel and do many different things. ”

In 1992, Franz received his bachelor’s degree in Physics, with a track in space physics, from the US Air Force Academy. After graduation, he was commissioned by the US Air Force and has worked in nuclear treaty monitoring, electronic warfare modeling and simulation. Additionally, he has taught physics at the US Air Force Academy as an assistant professor. In 1997, he received his master’s degree from the Air Force Institute of Technology. His thesis efforts involved studying carrier dynamics of quantum well semiconductor lasers over the nanosecond time scales.

In 2004, Franz was selected to enter a PhD program and return to teach at the Academy under the condition that he finished in three years. In August of that year, he was admitted into the Physics program at the University of Maryland. He worked under Professor Raj Roy.

“I came to UMD because I wanted to study the nonlinear dynamics of lasers,” said Franz. “The nonlinear

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RESEARCH SPOTLIGHT

Templating for Directed Self Assembly
By: Raymond Phaneuf

Recognizing that nature seems to be capable of producing extremely large numbers of structures at a rapid rate suggested that a solution to the problem of creating high densities on nm scale structures is self assembly. Self incidently. Langmuir and Blodgett carried out experiments in self assembly in the early years of the 20th centu obvious form of self assembly has been carried out by nature shortly after the universe formed and cooled to wh The problem with self assembly is that you generally get only those structures that nature will provide. The researchers, including my group, are now pursuing, seems to be directed self assembly, in which a template is quickly assembling large arrays of structures.

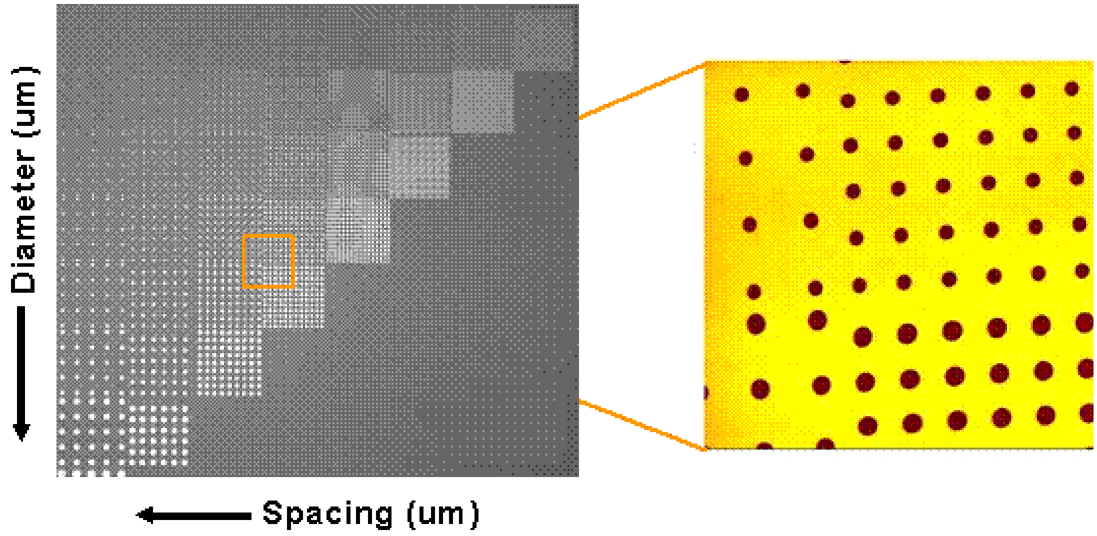

Fig. 1. Patterned GaAs(001) surface containing arrays of cylindrical pits, 50 nm deep, with varying diameter ar

We make the template in a number of different ways-lithography followed by etching, and "nanoscraping" are the at present. The first relies on depositing a "resist", usually a polymeric film onto a surface, and then selectively c regions to be removed or left in place. This can be done by irradiating it through a mask with UV light, or irrad scanned electron beam-both change the resistance of the polymer to being washed away by a chemical "develo atomic force microscope to selectively scrape away resist; and allows for extremely small patterns to be mad surface, parts of which are covered with resist, others bare, is exposed to a plasma which etches away the to removed chemically, leaving a clean but topographically patterned surface, a template.

The beauty of this approach is that many patterns can be explored simultaneously, allowing the effect of th explored. An example is shown in Figure 1, where we have defined pits of varying diameters and spacings ontc We now grow more GaAs onto this template, and observe the effect of the length scale on how new structures s We find that large period structures amplify during growth: the pits effectively grow deeper, while those whos characteristic size relax during growth. This characteristic size moves to larger values as we grow thicker films, period structures relax, but the surface shows a transient instability. We've explored the temperature dependenc the instability changes beneath ~540 C; rings of material form around pits during growth beneath this. We e: competing kinetic effects: one is associated with a barrier that atoms feel on difusing across a step from abov temperatures. The second is a faster collection of atoms by larger terraces, important at high temperatures. In our patterns downward to nanometer dimensions.

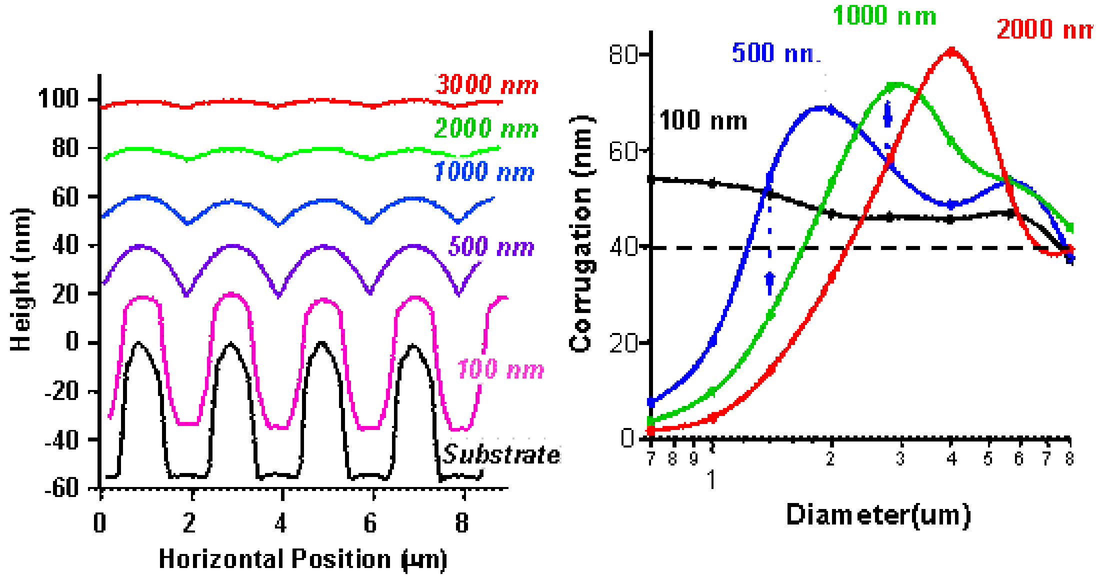

Fig. 2. (Left) Height profiles across patterned GaAs(001) for 1 um pits spaced at 2 um, vs. thickness of grown film, (I diameter and spacing. (right) Measured peak-valley height of patterns vs. initial diameter for different grown thickness larger than the peak value amplify, those beneath it decay

In related experiments, we have patterned stepped silicon surfaces, and measured how the length scale of assembly of bunches of steps during heating in vacuum. Beneath a characteristic length scale bunches of stra this the bunches form near sinusoidal shapes, with the waviness of the bunches decaying at the same rate as the set both by the stiffness of the steps and their interactions.

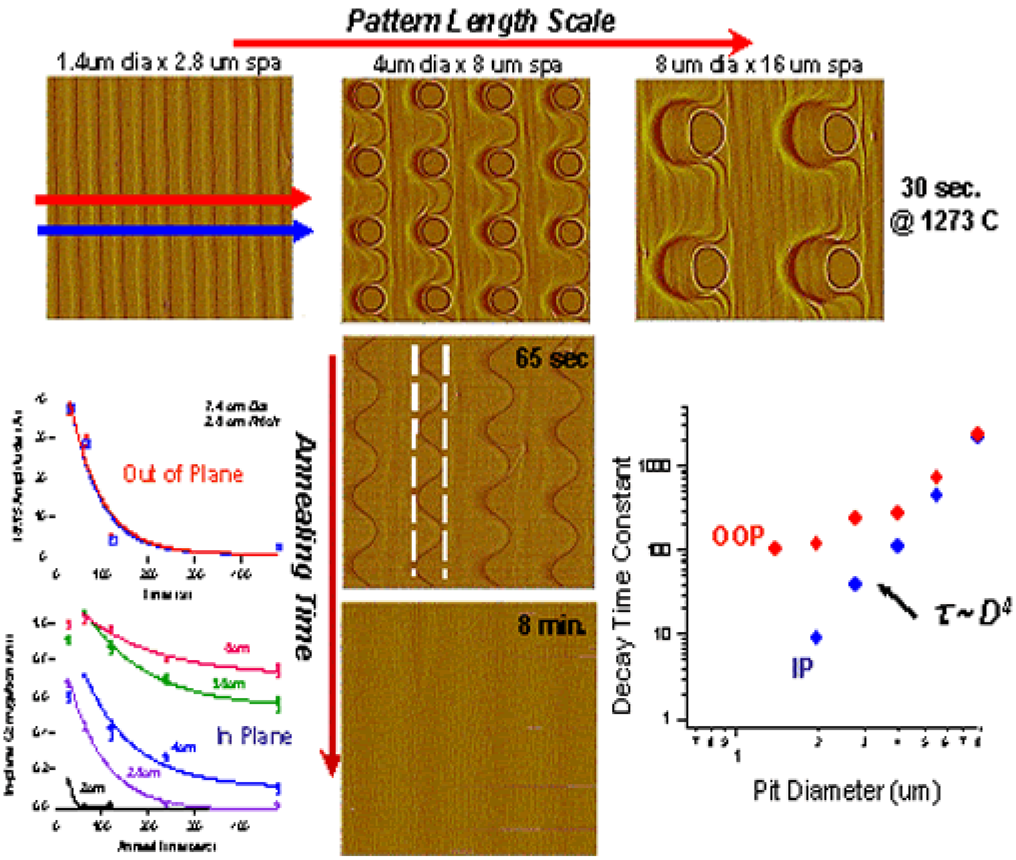

Fig.3. Self assembly of straight step bunches during annealing of short period patterned stepped Si(111), but wavy step bunches for long period patterns. The decay times for step bunch waviness (IP) and height (OOP) are different for small periods, but converge for large pattern structures

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dynamics group [at Maryland] is very highly regarded…I really enjoyed my time at Maryland. Being a student is a selfish time in your career when you only have to worry about your own development."

Franz received his PhD in the spring of 2007. He worked in the Institute for Research in Electronics and Applied Physics (IREAP) in nonlinear dynamics of lasers. His dissertation was titled "Dynamics and Synchronization of Nonlinear Oscillators with Time Delays: A study with Fiber Lasers." His time at Maryland was different than most student's. The Air Force continued to pay for his salary, therefore he was never a TA and was forced to stay on a restrictive timeline. This had its advantages, but it also made it difficult to specialize in one area of research deeply. If your goal is to complete your degree in quickly, Franz offers the following advice:

1. Pick an advisor and a topic as soon as possible (I had my advisor before I came to Maryland). Make sure your advisor understands your time limit and has work that is capable of being completed quickly.
2. Start on your research immediately, even if it's slow the first year. Suck as much knowledge out of the other graduate students in the lab, especially if they are leaving.
3. Pass your quals by the end of your first year. I took the first year courses and and did a little research, but you need to knock these out so you can focus on the research. Take the free try, even if you do little to prep for it. You can see how the test taking process works. And, maybe you'll get lucky.
4. Waive out of grad lab if possible. This buys a semester.
5. Decide if you really WANT to finish in three years. There were some courses I would have liked to have taken but couldn't because I didn't have time. Additionally, some research projects that are important and well-worth doing just took longer to build and setup so your choice of projects will be more limited.