General Audience Abstract

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Materials science is, at the most fundamental level, the science of discovering and characterizing new materials. The Materials Discovery group at NREL seeks to uncover novel materials which have the potential to be used to produce newer, more efficient solar cells, batteries, and many other devices. One class of material of particular interest to this group are nitrides, which are compounds of at least one positively-charged element bonded with nitrogen. Nitrides are a relatively unexplored material despite being predicted to have a wide variety of useful applications. My research focused on implementing the technology to produce these nitride materials in a layered form, which could allow for unique and potentially beneficial material properties.

For my Science Undergraduate Laboratory Internship, I worked on installing and testing the tools required to produce layered thin-film nitrides in one of our thin-film sputtering chambers. In a high-vacuum sputtering chamber, ions within a plasma are propelled at high velocity towards the surface of a metal “target”. When these ions collide with the target, it causes individual atoms of the material to be expelled in the direction of the surface on which the film is to be deposited. The films produced by this sputtering chamber can be anywhere from 20 nanometers to a few microns thick. For reference, a human hair is typically 20 microns in diameter and the films that I produced were around 200 nm, or 1/100th as thick.

To implement the ability to produce layered films in this chamber I first installed special thickness sensors within the chamber to determine deposition rate of the different materials. I then adapted a computer program which allowed for automatic opening and closing of the shutters covering each target. By adjusting the amount of time each shutter was open I was able to precisely control the individual layer thickness. The presence of layered deposition in the films was confirmed by a variety of characterization techniques. This result shows promise for future applications of this layered deposition technology in thin film nitrides and beyond.

As a SULI at NREL, I explored a plethora of new subjects within scientific research. I gained a deeper understanding of what a career working in renewable energy research looks like. I also learned how to work on a professional team in a modern research setting. My work on thin films exposed me to several different material characterization techniques such as X-ray diffraction, X-ray fluorescence and ellipsometry. As these techniques have broad applications within the field of material science, this knowledge will be invaluable as I pursue a graduate education/career in engineering.