Microchips that make pictures: Nano-technology and image sensors

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Image sensors are ubiquitous. They are in everyone's cell phones, laptops, security systems, and even in hallways and meeting rooms. The vast majority of these cameras are based on silicon technology, the same technology that brought us computer chips and USB thumb drives. Advanced image sensors go well beyond these traditional picture-taking cameras. Detecting wavelengths and modalities that humans don't normally see have become extremely important in a number of applications. Infra-red imaging, for example, can "see in the dark" because it detects wavelengths that every object emits due to its own temperature. Hence it does not need any external illumination, and has tremendous value in defense, security and surveillance. Another modality is polarization imaging. Human eyes don't have the ability to distinguish between polarized light and unpolarized light. However, polarization contains important information about the object it is being emitted from. It can detect material texture and distinguish manmade objects from natural objects. This modality has great potential for applications in search and rescue and environmental monitoring. What makes all of these technologies possible is our ability to carve out and sculpt a raw material (such as silicon) into useful structures. This is nanofabrication.

In this talk I will showcase UD's nanofabrication capability and the things we can make in our lab. Specifically, I will discuss two image sensing technology we are currently pursuing, which build on our capability to make components at the nanoscale. The first is infrared image sensors. We are advancing the state-of-the-art infrared image sensors by exploiting certain nanoscale effects and thin film processes of narrow bandgap semiconductors. The goal is to improve the manufacturability of these cameras and bring down their cost. The second technology is polarization imaging. We are using visible image sensors, which are cheap and abundant, and adding polarization capability to these sensors. This is done by making metallic nanowires oriented along different directions on each pixel of the image sensor. The entire process, from start to finish, is conducted in our labs at the University of Dayton campus.