Corinne Kingsley

Biography

I grew up on a farm in a rural area of upstate New York. For as long as I can remember, I have been interested in understanding how and why things work. As a kid, my dad was always helping me take things apart so that I could see what exactly was going on inside. He would let me assist with projects around the house, answer all my questions, have me do calculations and let me use all of his tools. These interests continued throughout middle school and high school. They led me to focus on taking math and science classes, where I discovered my passion for chemistry and physics. I loved doing the labs for these classes, making predictions about what would occur and then proving or disproving my hypotheses.

Apparently, my love for science was obvious to those around me. During my junior year of high-school, my physics teacher approached me with an amazing opportunity. He asked if I would like to travel with him and two of my classmates to Mae Sot, Thailand to volunteer for the summer. I, of course, took the offer and spent my summer building photovoltaic systems at schools and medical clinics along the Thai/Burma border. The systems were used to power lights so that students could study at night without the need to use candles or a generator. At the clinic, we installed lights in the operating room so doctors would be able to perform surgeries with adequate lighting. We also built ultra-violet light water purifiers to run off the solar powered systems to provide clean drinking water. In addition, we developed lessons to teach the students and medics how to use and maintain the systems we installed. Through a translator, we taught classes and gave demonstrations on how energy from the sun could be collected using solar panels and stored in batteries to power their lights and electronics. This was not only my first experience with teaching but also a life changing trip that opened my eyes to major impacts of science and alternative energy on people's lives.

After I graduated from high school, I attended St. John Fisher College in Rochester, NY where I studied both chemistry and physics. Following my interests in solar energy, I participated in a Research Experience for Undergraduates (REU) program at the Pennsylvania State University. Working in Dr. Raymond Schaak's lab, I studied copper sulfide and copper selenide nanoparticles as potential materials for making more efficient solar cells. In particular, I worked on post-synthetic alterations of their composition to change their absorptive properties. I really enjoyed working in a lab during this experience and decided to continue my education in the Department of Chemistry at Cornell University.

Outside of the lab, I love exploring the outdoors and playing sports. My favorite activities are playing softball and hiking in the parks around Ithaca and the Adirondacks. When I cannot adventure in the fresh air, I also enjoy watching baseball during the summer, and hockey and football in the winter.

Research

In the summer of 2012, after my graduation from SJFC, I was able to return to Thailand once more to bring renewable energy to schools. I was fortunate enough to return to two of the locations where I worked on my first trip and see, to my delight, that the systems we installed still functioning and being used. Although I was able to see the tremendous impact those silicon solar panels have had, obtaining solar energy in this way is very expensive and inefficient. A great deal of research is being done today in order to find materials that would be more cost effective and yet still capable of effectively capturing solar energy for our use. When I arrived at Cornell University, I joined Prof. John Marohn's research group to contribute to this work.

Organic materials are a good candidate for use in solar cells because they can have suitable electrical, chemical, mechanical and optical properties and are relatively inexpensive to produce. However, their properties and the internal processes that would make them efficient solar cell materials are not well understood. In order to better understand how these materials work, so that even better materials can be effectively engineered, I am working toward using magnetic resonance force microscopy (MRFM) to study organic solar cell devices. MRFM can be used as a magnetic resonance imaging (MRI) technique. This is the same concept that would be used in a doctor's office to obtain a 3D image of your brain, but is much more sensitive in detecting small numbers of nuclear or electron spins. The goal of my research is to be able to image charges, or electron spins, moving through organic solar cell devices so that we can better understand what makes certain materials better candidates for applications than others. A clearer understanding of how charges move through these devices in three dimensions (especially below the surface), would allow scientists to more effectively design new materials that would make organic solar cells more efficient and increase our ability to capture and use energy from the sun.

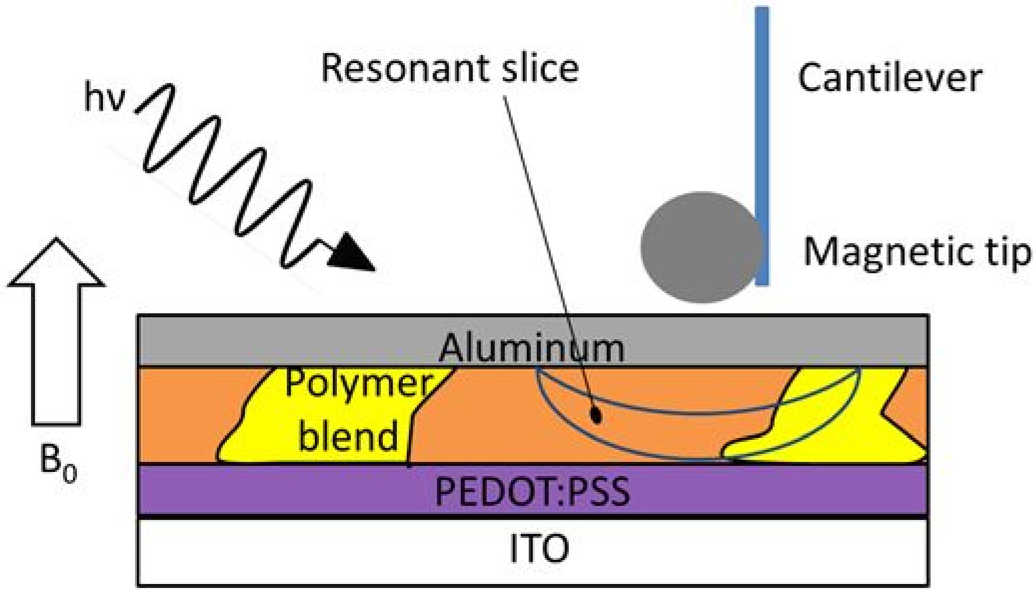

Figure 1. MRFM uses a magnetic tipped cantilever in the presence of an external magnetic field (B_0) to mechanically detect a magnetic resonance signal. The magnetic tip provides the magnetic field gradient necessary to do imaging experiments. Only the spins experiencing a specific magnetic field, the spins in the 'resonant slice', are able to contribute to the signal. This schematic shows how an MRFM experiment could be done on an organic solar cell device to image the 3D structure (looking at nuclear spins) or charges in the device (looking at electron spins).