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Using a Combined Atomic Force and Confocal Microscope for Nanoscale Magnetic Sensing with Nanodiamonds

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Color centers in diamonds have received significant attention recently for their magnetic field sensitivity at a nanoscale spatial resolution. This project encompasses an attempt to use nitrogen vacancy center defects in nanodiamonds to measure nanoscale magnetic fields with a combined atomic force and confocal microscope setup. The technique is to first locate a nanodiamond containing a nitrogen vacancy (NV) center. Once we have located a potential nanodiamond using the atomic force microscope, we verify the presence of an NV center by either applying an electronic spin resonance (ESR), or by looking at its luminescence spectrum and locating its signature zero phonon line. Once all the criteria have been met, we then attempt to attach the nanodiamond to the tip of the atomic force microscope. We investigate various methods of achieving this, including the use of Poly-L-lysine to coat the probe for an improved adhesion. During a topographic scan, the feedback to the scanner is cut and the setpoint or piezo stage is adjusted so as to apply pressure while the tip is passing over the nanodiamond. Once the nanodiamond is attached to the tip, it can then be used to measure magnetic fields by measuring the shift in the ESR spectrum. The NV center has a drop in luminescence when microwaves with a frequency of approximately 2.87 GHz are applied. When in the presence of a magnetic field, the Zeeman Effect causes this signal to split. It is this splitting which is directly proportional to the magnetic field and allows us to measure it. In this poster, we will present our current progress and discuss some of the obstacles we have encountered along the way. This technique will allow the recording of a topographic and a magnetic field image with the same atomic force microscope tip at ambient temperatures.

Biography

Richard Escalante de Posada is completing his 2nd year PhD. program at the Pontificia Universidad Católica de Chile. He completed his undergraduate at the University of California, Santa Cruz.

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