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A New Sensing Dimension or Carbon Copy? Widefield Defect Microscopy Beyond Diamond

Monday 1 December 2025 15:00 (30 minutes)

Widefield defect microscopy is an emerging technology that provides spatially resolved quantitative maps of useful quantities, foremost of magnetic fields. These microscopes use color center spins in a crystalline host, which are controlled and measured optically to detect perturbations caused by fields in a proximal sample. Initial excitement around the nitrogen-vacancy (NV) defect in diamond led to a range of proof-of-concept demonstrations across diverse applications—from condensed matter to biology—using a rudimentary yet versatile setup. More recently, the field has shifted toward advanced, application-specific configurations, alongside emerging commercial solutions.

In this talk, I will briefly review the state of the art in the established widefield NV microscopy platform and broadly address its challenges and opportunities. I will then discuss results highlighting inaccuracies caused by optical aberrations and demonstrate magnetic current imaging of photovoltaic devices as examples of these two categories.

Researchers are now investigating alternative defects and material hosts to overcome some of NV-diamond's limitations. Of foremost interest are novel defects in two-dimensional materials, where the ability to exfoliate a sensor down to an atomically thin sheet allows for simple control over sample-sensor standoffs. The final portion of this talk discusses two such defects in hexagonal boron nitride: the boron vacancy centre and an unidentified visible emitter. The first widefield imaging demonstrations using these systems, as well as their comparative advantages and disadvantages relative to NV-diamond, are presented. We then analyze results identifying the spin multiplicity of the visible defect and tentatively classify it as a weakly coupled pair of carbon substitutions.

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