Tools for nanoscale quantum metrology in physical and biological systems using optically detected magnetic resonance (ODMR) of nitrogen vacancy centers in diamond

The nitrogen vacancy (NV) defect center in diamond forms a pseudo-atomic quantum system with discreet optically excitable transitions between ground and excited states in the gap between valence and conduction bands, making the NV center a deep-level defect center in diamond. For the negatively charged NV center (NV⁻), both the ground and excited states are spin triplets (S=1) and coupling between optical and spin states provides unique opportunities for optical detection of magnetic resonance (ODMR) and quantum metrology under ambient conditions. As an atomically sized point defect that is stable in single nanodiamonds as small as a few nanometers, the NV center enables spin based imaging of temperature, electric fields, magnetic fields and mechanical strain with nanoscale spatial resolution. Made of carbon, nanodiamonds are also ideal nanoparticles for use in biological systems, exhibiting extremely low cytotoxicity, no photo bleaching and exceptional contrast in transmission electron microscopy. I will present our labs progress in developing novel NV diamond magnetic resonance based imaging systems and bio-functionalized nanodiamond probes.

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