Nanoscale magnetometry with single spins

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Abstract

Quantum two-level systems offer attractive opportunities for sensing and imaging at the nanoscale. In the fifteen years since its inception, this idea[1] has advanced from proof of concept[2] to a mature quantum technology[3], which already finds applications in condensed matter physics, materials science and engineering. In this talk, I will present the key engineering challenges[4] we have addresses in this development and highlight particularly rewarding applications of single-spin, scanning probe microscopy.

Specifically, I will discuss how we employ single electronic spins in diamond for nanoscale probing of antiferromagnetic systems[5-9] and high-resolution imaging of atomically thin "van der Waals" magnets[10-11]. For both, the combination of sensitivity, spatial resolution and quantitative imaging enables unprecedented insights such as quantitative imaging of nanoscale domains[8] and domain-walls[9] in antiferromagnets and nanoscale imaging of spin textures in magnetic systems down to the atomic monolayer limit[11].

I will conclude with an outlook of future developments of single spin magnetometers for extreme conditions, such as high magnetic fields, millikelvin temperatures or for high-frequency sensors to probe the dynamics of nanomagnetic systems.

References

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