A practical quantum sensing wide-field probe for precision magnetic imaging

I. O. Robertson[a], G. J. Abrahams[a], S.C. Scholten[b], Priya Singh[a], A. J. Healey[b] and J.-P. Tetienne[a]

[a]*School of Science, RMIT University, Melbourne, VIC 3001, Australia.*

[b]*School of Physics, University of Melbourne, VIC 3010, Australia.*

Quantum sensors are rapidly emerging as highly sensitive metrology devices with a wide scope of applicability, employing the delicate nature of quantum systems to probe the local environment [1]. One of the leading quantum systems studied for its use as a sensor is the nitrogen-vacancy (NV) defect in diamond, which has been implemented in a diverse collection of sensing devices for notable applications in thermometry, chemical analysis, and magnetometry [2]. The wide-field nitrogen-vacancy (NV) microscope is a particular sensing device which exploits an array of NVs embedded in a diamond to optically collect spatially correlated maps of the magnetic field from suitably interfaced magnetic objects. Appealing aspects of the wide-field NV microscope are its quantitative, calibration free imaging [3]. However, so far there has not been widespread adoption of the wide-field NV microscope as interfacing the diamond with a sample requires trained expertise. Here we present a practical solution for eliminating the necessary expertise by developing a fully integrated diamond probe which enables reliable interfacing with the sample. The capabilities of our approach are demonstrated by imaging a test magnetic thin-film [4]. Furthermore we show some example applications of the wide-field NV microscope to the study of 2D van der Waals magnets, 2D spintronic phenomena, and photocurrents in photovoltaic devices [5, 6, 7]. Development of a practical instrument will facilitate broader application of wide-field NV microscopy to various areas of physics, materials science and beyond.

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