Applied Magnetic Resonance 2016 vol.47 N7, pages 793-812

Spin Centres in SiC for Quantum Technologies

Astakhov G., Simin D., Dyakonov V., Yavkin B., Orlinskii S., Proskuryakov I., Anisimov A., Soltamov V., Baranov P.

Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

© 2016, Springer-Verlag Wien.Atomic-scale colour centres in bulk and nanocrystalline SiC are promising for quantum information processing, photonics and sensing at ambient conditions. Their spin state can be initialized, manipulated and readout by means of optically detected magnetic resonance. It has been shown that there are at least two families of colour centres in SiC with S = 1 and S = 3/2, which have the property of optical alignment of the spin levels and allows a spin manipulation. The ground state and the excited state were demonstrated to have spin S = 3/2 and a population inversion in the ground state can be generated using optical pumping, leading to stimulated microwave emission even at room temperature. By controlling the neutron irradiation fluence, the colour centres concentration can be varied over several orders of magnitude down to a single defect level. Several, separately addressable spin centres have been identified in the same crystal for each polytype, which can be used either for magnetic field or temperature sensing. Some of these spin centres are characterised by nearly temperature independent zero-field splitting, making these centres very attractive for vector magnetometry. Contrarily, the zero-field splitting of the centres in the excited state exhibits a giant thermal shift, which can be used for thermometry applications. Finally coherent manipulation of spin states has been performed at room temperature and even at temperatures higher by hundreds of degrees. SiC is taking on a new role as a flexible and practical platform for harnessing the new quantum technologies.

http://dx.doi.org/10.1007/s00723-016-0800-x