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Spin Technologies in Silicon Carbide[1]

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Over the past several decades SiC has evolved from being a simple abrasive to a versatile material platform for high-power electronics, optoelectronics, and nanomechanical devices. These technologies have been driven by advanced growth, doping, and processing capabilities, and the ready availability of large-area, single-crystal SiC wafers. Recent advances have also established SiC as a promising host for a novel class of technologies based on the spin of intrinsic color centers. In particular, the divacancies and related defects [1,2] have ground-state electronic-spin triplets with ms-long coherence times that can be optically addressed near telecom wavelengths [3] and manipulated with magnetic, electric [4], and strain fields [5]. Recently, divacancy addressability has been extended to the single defect level [6], laying foundation for single spin technologies in SiC. This rapidly developing field has prompted research into the SiC material host to understand how defect-bound electron spins interact with their surrounding nuclear spin bath. Although nuclear spins are typically a major source of decoherence in color-center spin systems, they are also an important resource since they interact with magnetic fields orders of magnitude more weakly than electronic spins. This fact has motivated their use for quantum memories and ultra-sensitive sensors. In this talk I will review advances in this rapidly developing field and discuss our efforts towards this latter goal.

[1] Koehl, et al., Nature 479, 84 (2011).
[2] Falk, et al., Nat. Comm. 4, 1819 (2013).
[3] Calusine, et al., APL 105, 011123 (2014).
[4] Klimov, et al., PRL 112, 087601 (2014).
[5] Falk, et al., PRL 112, 187601 (2014).
[6] Christle, et al., Nat. Mat. accepted (2014).

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