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Unconventional nuclear magnetic resonance techniques using nanostructured diamond surfaces VICTOR ACOSTA, Google [x], Mountain View, CA, ANDREY JARMOLA, DMITRY BUDKER, UC Berkeley Physics Dept., Berkeley, CA, CHARLES SANTORI, ZHIHONG HUANG, RAYMOND BEAUSOLEIL, Hewlett-Packard Laboratories, Palo Alto, CA — Nuclear magnetic resonance (NMR) technologies rely on obtaining high nuclear magnetization, motivating low operating temperatures and high magnetic fields. Dynamic nuclear polarization (DNP) techniques traditionally require another superconducting magnet and THz optics. We seek to use chip-scale devices to polarize nuclei in liquids at room temperature. The technique relies on optical pumping of nitrogen-vacancy (NV) centers and subsequent transfer of polarization to nuclei via hyperfine interaction, spin diffusion, and heteronuclear polarization transfer. We expect efficient polarization transfer will be realized by maximizing the diamond surface area. We have fabricated densely-packed (50% packing fraction), high-aspect-ratio (10+) nanopillars over mm^2 regions of the diamond surface. Pillars designed to have a few-hundred-nanometer diameter act as optical antennas, reducing saturation intensity. We also report progress in using nanopillar arrays as sensitive optical detectors of nano-scale NMR by measuring NV center Zeeman shifts produced by nearby external nuclei. The enhanced surface area increases the effective density of NV centers which couple to external nuclei. Combining these techniques may enable, e.g., identification of trace analytes and molecular imaging.

Victor Acosta
Google [x], Mountain View, CA

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