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Engineered diamond nanopillars as mobile probes for high sensitivity metrology in fluid[1] P. ANDRICH, C.F. DE LAS CASAS, F.J. HEREMANS, D.D. AWSCHALOM, University of Chicago, B.J. ALEMAN, K. OHNO, UC Santa Barbara, J.C. LEE, E.L. HU, Harvard University — The nitrogen-vacancy (NV) center‘s optical addressability and exceptional spin coherence properties at room temperature, along with diamond‘s biocompatibility, has put this defect at the frontier of metrology applications in biological environments. To push the spatial resolution to the nanoscale, extensive research efforts focus on using NV centers embedded in nanodiamonds (NDs). However, this approach has been hindered by degraded spin coherence properties in NDs and the lack of a platform for spatial control of the nanoparticles in fluid. In this work[2], we combine the use of high quality diamond membranes with a top-down patterning technique to fabricate diamond nanoparticles with engineered and highly reproducible shape, size, and NV center density. We obtain NDs, easily releasable from the substrate into a water suspension, which contain single NV centers exhibiting consistently long spin coherence times (up to 700 μs). Additionally, we demonstrate highly stable, three-dimensional optical trapping of the nanoparticles within a microfluidic circuit. This level of control enables a bulk-like DC magnetic sensitivity and gives access to dynamical decoupling techniques on contactless, miniaturized diamond probes.

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[2]P. Andrich *et al.*, Nano Lett. 14, 4959 (2014).

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