Nanoscale NMR Advances

Technique detects various nuclei, structural features

By Jyllian Kemsley

With an eye toward getting chemical and three-dimensional structural information from individual biomolecules or nanoscale features of a material, three research groups report advances in using diamond defects as NMR detectors under ambient conditions (Nat. Nanotechnol. 2014, DOI: 10.1038/nnano.2014.288 and 2015, DOI: 10.1038/nnano.2014.299 and 10.1038/nnano.2014.313). The diamond defects are called NV centers and consist of a nitrogen atom and an adjacent lattice vacancy in place of a pair of adjacent carbon atoms. The fluorescence from NV centers is sensitive to magnetic fields emanating from just outside the diamond. Researchers previously demonstrated that the centers could be used to detect NMR signals of polymer hydrogens in sample volumes as small as 5 nm$^3$. In the new work, teams led by Daniel Rugar of IBM, Friedemann Reinhard and Jörg Wrachtrup of Germany’s University of Stuttgart, and Ronald L. Walsworth of Harvard University demonstrate that the centers can sense and distinguish between $^1$H, $^{19}$F, and $^{31}$P signals. The researchers were also able to produce 2-D structural images with submicrometer resolution. All three teams scanned samples across individual NV centers. Walsworth’s group also used an ensemble of centers and a charge-coupled device camera to image multiple nuclear species in a region measuring 50 µm$^2$. 

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