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Single Molecule Electron Paramagnetic Resonance RICHELLE M. TEELING-SMITH, EZEKIEL JOHNSTON-HALPERIN, MICHAEL G. POIRIER, P. CHRIS HAMMEL, The Ohio State University — Electron paramagnetic resonance (EPR) is a powerful spectroscopic tool for studying the dynamics of biomolecular systems. EPR measurements on bulk samples using a commercial X-band spectrometer provide insight into atomic-scale structure and dynamics of ensembles of biomolecules. Separately, single molecule measurements of biomolecular systems allow researchers to capture heterogeneous behaviors that have revealed the molecular mechanisms behind many biological processes. We are merging these two powerful techniques to perform single molecule EPR. In this experiment, we selectively label double-stranded DNA molecules with nitrogen-vacancy (NV) center nanodiamonds and optically detect the magnetic resonance of the NV probe. Shifts and broadening of our EPR peaks indicate the changing position of the attached DNA relative to the applied magnetic field. Using this new technique, we have successfully measured the first EPR spectrum of a single biomolecule. By controlling the geometry of the diamond and the applied magnetic field, we will quantitatively determine the rotational and translational dynamics of single biomolecules. This research provides the foundation for an advanced single molecule magnetic resonance approach to studies of complex biomolecular systems.

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