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Probing molecular dynamics at the nanoscale via an individual paramagnetic center TOBIAS STAUDACHER, 3rd Institute of Physics and Research Center SCOPE, University Stuttgart, NICOLE RAATZ, SEBASTIEN PEZZAGNA, JAN MEIJER, Institute for experimental physics II, University of Leipzig, FRIEDEMANN REINHARD, Walter Schottky Institut, Technical University Munich, CARLOS MERILES, CUNY-City College of New York, JOERG WRACHTRUP, 3rd Institute of Physics and Research Center SCOPE, University Stuttgart — We use shallow NVs to probe mesoscale proton ensembles from different substances deposited on the diamond surface. We resort to a form of correlation spectroscopy to reconstruct the equivalent of a nuclear "free-induction-decay" (FID), which, unlike the NMR counterpart, does not require nuclear spin pre-polarization. This pseudo FID has a limit decay time governed by the NV spin-lattice relaxation time T1 (typically longer than the NV coherence lifetime T2), which allows us to attain spectral resolution superior to that possible with standard magnetometry techniques. Upon applying this scheme to solid- and liquid-state substances we find substantial differences in the correlation signal lifetime, which we associate with the presumably different molecular dynamics governing these systems. In particular, we observe long-lived 1H signals from oil molecules, likely a consequence of the interplay between fast molecular tumbling and slow self-diffusion.

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