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Amplified nanoscale detection of labeled molecules via surface electrons on diamond

The development of new sensing techniques that reach nanoscale resolution would habilitate the detection of single molecules as well as their dynamics. In this regard, we present a detection protocol using a nitrogen vacancy center quantum sensor to measure the coupling between two electronic targets on a macromolecule via a dangling bond. The latter is an unpaired immobilized electron, which tends to appear on the diamond surface. In particular, we have designed a multi-tone dynamical decoupling sequence that transforms the dangling bond into an amplifier of the target parameters leading to enhanced detection. Furthermore, our method reduces the effects of decoherence on both the nitrogen vacancy center and the dangling bond, allowing them to be limited by thermalization rather than by dephasing. This proposal has the potential to open up new avenues for fundamental research and technological innovation in distinct areas such as biophysics and biomedicine.

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