Enhancing polarization transfer from nitrogen-vacancy centers in diamond to external nuclear spins via dangling bond mediators

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The use of nitrogen-vacancy (NV) centers in diamond as a non-invasive platform for hyperpolarizing nuclear spins in molecular samples is a promising area of research with the potential to enhance the sensitivity of nuclear magnetic resonance (NRM) experiments. Transferring NV polarization out of the diamond structure has been achieved on nanoscale targets using dynamical nuclear polarization methods, but extending this to relevant NMR volumes poses significant challenges. One major technical hurdle is the presence of paramagnetic defects in the diamond surface which can interfere with polarization outflow. However, these defects can also be harnessed as intermediaries for the interaction between NVs and nuclear spins. We present a method that benefits from existing microwave sequences, namely the PulsePol, to transfer polarization efficiently and robustly using dangling bonds or other localized electronic spins, with the potential to increase polarization rates under realistic conditions.

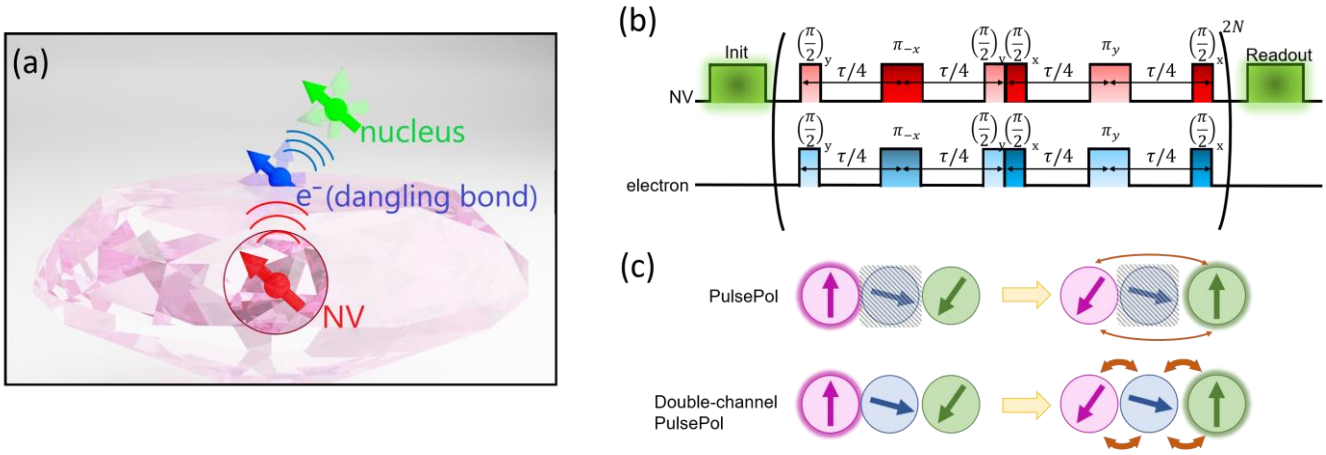

Figure 1 Schematics of the proposed protocol. (a) The NV transfers its polarization state through an intermediate electron at the diamond surface. (b) Schematics of the microwave pulse sequence on the NV and the electron spin for pulsed polarization transfer. (c) Comparison between the direct PulsePol scheme and the double-channel PulsePol. In the latter, the electron interacts coherently with the NV and the nearby nuclei to mediate the polarization process. The introduction of the electron as mediator allows for stronger interactions and thus faster protocols.

References

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