Rare Earth-Diamond Hybrid Structures for Optical Quantum Technologies

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Hybrid materials that associate distinct quantum species may be used to achieve new functionalities. In this work, we combine two systems that are broadly used for quantum applications, the NV^- color center in diamond [1] and rare earth (RE) ions doped in crystals [2].

The hybrid structure we studied consists of an Er^{3+} doped Y_2O_3 thin film deposited by direct liquid injection chemical vapor deposition (CVD) [3] on a diamond substrate in which shallow NV^- were implanted [4].

We investigated the structure of the thin films and the optical properties of the embedded Er^{3+} ions (Fig. 1), and how the spin and optical properties of the NV^- were affected by the thin film deposition. Our results indicate that erbium ions are in a high-quality crystalline environment, while the optical and spin properties of the NV^- centers are preserved after deposition.

These results suggest that the proposed structure is promising for integrating rare-earth ions with NV^- centers at the nanoscale level for developing hybrid solid state quantum systems.

References

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Figures

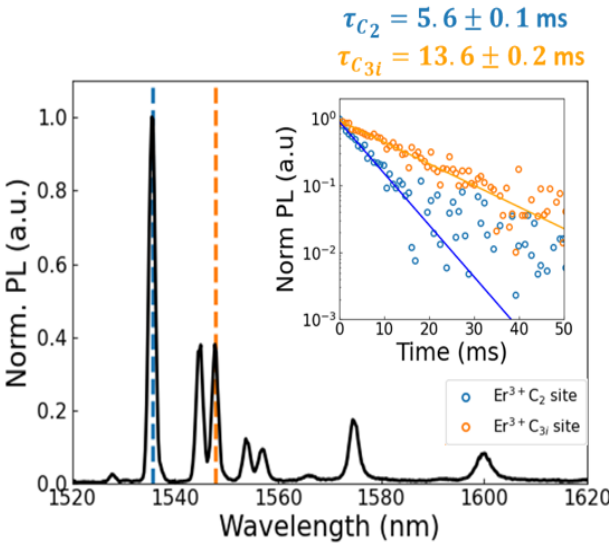

Figure 1: Low temperature telecom band emission in a Er:Y_2O_3 thin film deposited on diamond and fluorescence decay times (inset). Properties are comparable to bulk crystals.