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# Microwave-to-optical photon conversion via NV-center spin ensembles

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## Abstract

We report a spin-ensemble-based microwave-to-optical transducer employing nitrogen-vacancy (NV) centers in diamond. The system combines a rutile dielectric microwave resonator ( $Q_{\text{int}} > 10^4$ ) with a diamond-integrated Fabry-Pérot optical cavity operated at 10–20 mK. Under coherent optical pumping of the NV ensemble, we observe heterodyne signals corresponding to up-converted microwave excitations at  $\sim 5.6$  GHz. The present conversion efficiency ( $\sim 10^{-12}$ ) is mainly limited by spatial and spectral mode mismatches between the microwave and optical cavities.

**Keywords:** NV centers, quantum transduction

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