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# Hybrid diamond quantum photonics

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Integrated on chip quantum systems is one of the promising routes to achieve scalable quantum information devices. The key for any quantum information system is the quantum source. Optically active impurities (color centers) in diamond act as excellent candidates of quantum sources. They deliver anti-bunching single photons with high photo-stability that persist, even at the room temperature. The light emission properties of the color center can be significantly enhanced by means of an optical cavity. As diamond is hard to mould and shape, making on-chip micro-cavities is strenuous. Consequently, a hybrid approach is often explored. Here the diamonds are either in nano-diamond or un-patterned blanket form and their optical emission is evanescently coupled to the optical micro-cavities, created using CMOS fabrication-friendly material platforms. However, the achievable emission enhancement is limited due to the evanescent interaction between the electrical field of the cavity and the nano-diamond. We introduce a diamond in nano-pocket structure as a new route to achieve a high enhancement in the hybrid system. Specifically, we demonstrate that by creating a nano-pocket within the L3 photonic crystal cavity and placing the nano-diamond in a significant and a robust control over the local density of states can be obtained. Using a silicon nitride photonic crystal L3 cavity and aiming at SiV and NV color centers in diamond, we performed a statistical analysis of light emission assuming random positions of color centers and dipole moment orientations. We showed in cavities with experimentally feasible quality factors, the diamond in nano-pocket structure produces Purcell factor distributions with mean and median that are ten-fold larger compared to what can be achieved when the diamond is on the surface of the micro-cavity.

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