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Quantum Photonics using color centers in diamond membrane coupled to a photonic structure

In recent years, color centers of crystal systems have drawn a lot of attention due to their superior properties for quantum technology. By definition color centers are a certain class of point defects created by vacancies, misplaced atoms, or atom-vacancies complexes with the ability to photoluminesce, in addition, they can also be paramagnetic and responsive to magnetic fields. The most popular host containing the color centers is the diamond, more than half a thousand color centers have been identified in diamonds and nearly a dozen of them are capable of single-photon emission. Among those color centers Germanium-vacancy (GeV), Silicon-vacancy (SiV) and Tin-vacancy (SnV) defects have been researched the most due to their various excellent optical properties such as narrow optical emission lines and high spectral stability.

One of the most promising applications of color centers in Quantum technology is to exploit them as single-photon emitters, recently intensive research has been carried out for developing methods to couple color centers to photonic circuits efficiently for quantum communication and linear-optical quantum computation(LOQC). Diamond wafers are costly to produce and hard to nanofabricate therefore it is challenging to realize a practical photonic device on a all-diamond platform, on the other hand the total internal reflection of the diamond makes it hard to couple the photoluminescence of color centers to other photonic structures. The current research project tries to address the aforementioned challenges by finding the optimized geometry and coupling interface/conditions for the integration of a diamond membrane containing a color center to a conventional glass-based photonic waveguide in order to realize a hybrid single-photon emitter in compliance with the criteria acceptable for LOQC components.

Very little to no study has been done regarding the integration of diamond membrane into the photonic waveguides which makes this project important and novel in its own kind not only in a scientific sense but also because it could pave the way towards a more feasible and scalable fabrication strategy for single-photon sources.

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