Solid-state nanophotonics: towards on-chip devices for the generation and manipulation of single photons

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Abstract

Photons are considered as ideal carriers of information in several applications of quantum information processing (QIP) since they are easy to generate by several means and manipulate with linear optics. In addition, the information encoded in photons using different degrees of freedom such as polarization, time bin, or path can be carried over long distances due to the weak interaction with their environment. However, several quantum protocols (e.g., quantum computation and quantum cryptography) require on-demand single photons as well as photons being indistinguishable from each other. Among several systems, semiconductor quantum dots (QDs) have generated a great interest as potentially bright and stable solid-state single-photon sources. Recent progress on advanced nanofabrication techniques enabled a controlled growth of semiconductor QDs, which can be integrated in different nanophotonic structures thus providing a suitable test bed for fundamental investigations in the field of solid-state quantum optics. In this talk, I will present our activities on (i) design and fabrication of nanophotonic structures (e.g., circular Bragg gratings and microdisk cavities) to enhance collection efficiency of single photons from individual QDs and (ii) using amplitude modulation [1] and quantum frequency conversion techniques [2] to improve the quality of the single photons and integrate them with disparate quantum systems.

Keywords: Single-photon sources, quantum dots, frequency conversion

References:

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