Single-photon emitters at telecom wavelength in silicon

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The boom of silicon in semiconductor technologies was closely tied to the ability to control its density of lattice defects [1]. After being regarded as detrimental to the crystal quality in the first half of the 20th century [2], point defects have become an essential tool to tune the electrical properties of this semiconductor, leading to the development of a flourishing silicon industry [1]. At the turn of the 21st century, progress in Si-fabrication and implantation processes has triggered a radical change by enabling the control of these defects at the single level [3]. This paradigm shift has brought silicon into the quantum age, where individual dopants are nowadays used as robust electrical quantum bits to encode and process quantum information [4]. Fluorescent defects recently isolated at single-defect scale in silicon [5,6] could follow suit. These new artificial atoms in silicon have the advantage of an optical interface at telecom wavelengths, and for some, combined with a non-zero electron spin state that could be used to locally store quantum information [7].

In this talk, I will present the latest developments on the isolation and control of single fluorescent defects in silicon. These individual color centers feature a single-photon emission directly in the telecom bands adapted for long-distance propagation in optical fibers. They are observed at single-defect scale in silicon-on-insulator wafers at 10K-30K using confocal microscopy. This technique makes it possible to isolate not only well-known defects from the literature [8,9], but also to detect unreported color centers in optical spectroscopy measurements on ensembles [10]. We will discuss the prospects and challenges of these promising systems for Si-based quantum technologies, including integrated quantum photonics and quantum communications.

References

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