**Abstract**

The capabilities of fabrication technologies and the ability to control the emission wavelength of quantum dots are the reasons of their expanding application areas, which nowadays include also quantum computing and quantum communication, particularly reaching also the fiberbased telecommunication. The concept of an ideal quantum emitter involves isolating a single quantum dot from a larger ensemble by creating a dedicated photonic structure using various available techniques. One of them is focused ion beam technology (FIB), which, in this context, has so far been employed in a very limited extent. Therefore, the aim of this work was to fill this gap and develop the FIB technology to a practical level. It is a fast and cost-effective technique for prototyping special structures and, in some cases, may serve as an alternative to the commonly used combination of electron beam lithography and etching. This work demonstrates the use of an optimized xenon plasma-focused ion beam process for the effective fabrication of functional photonic microstructures with quantum dots made from InGaAs/GaAs and InAs/InP semiconductor compounds, emitting in the second and third telecommunication bands. One of the main achievements was the application of the Xe-PFIB technique for the precise processing of structures with quantum dots covered by a very thin capping layer, in view of creating photonic structures of a simple design with spectrally broad extraction efficiency function. Bright emission at 1,55 μm was demonstrated from single quantum dots capped with a layer as thin as 150 nm, which is several times thinner than previously reported for FIBprocessed structures. Photonic structures with a high extraction efficiency (up to 24%, which represents state-of-the-art at the 1,55 μm range) were achieved, enabling the investigation of selected optical properties of the quantum emitters and the obtaining high purity (~99%) singlephoton emission coupled to a single-mode telecom fiber. Finally, it was shown for the first time that in this technological approach, combined with optical imaging, deterministic fabrication of microstructures with quantum dots and the creation of more complex photonic structures, such as circular Bragg gratings, is also possible. The limitations of the technique, such as the destructive effect of the ion beam, can be minimized by optimizing the FIB working parameters or using additional amorphous protective coatings. The most important conclusion of this dissertation is that FIB technology, despite the challenges related to the degradation of the material's structural and optical properties, has a great potential as a tool for prototyping efficient photonic structures and is useful to bring them closer to practical application in quantum communication schemes in the fiber networks.