Novel quantum optical devices based on droplet epitaxial GaAs/AlGaAs quantum dots

Huiying Huang [1*], Saimon Filipe Covre da Silva[1], Xueyong Yuan[1] and Armando Rastelli[1]

[1] *Institute of Semiconductor and Solid State Physics, Johannes Kepler University, Altenbergerstr. 69, A4040, Linz, Austria*

Epitaxial growth Semiconductor quantum dots (QDs) are currently popular as promising sources of single and entangled photon pairs in the future application in linear-optical quantum computation and quantum communication. Compared with the commonly studied InGaAs QDs, GaAs QDs have many advantages such as no built-in strain, controllable shape, flexible choice of composition, Fourier-limited emission, nuclear spin of Ga isotopes smaller than In, which make GaAs QD a good choice for quantum-dot entanglement sources in future quantum technologies. [1, 3] However, the absence of strain disables the common strain-driven growth method used for InGaAs QDs. Many new approaches have been developed to overcome this problem. For example, Al-droplet-epitaxy growth method is used here to obtain high quality GaAs/AlGaAs QDs. [2]

Another appealing feature of epitaxial QDs is that they can be embedded in various optical and electronic structures like optical cavity and p-i-n doped diode. [3] Combined with the post-grow processing, such as changing surface topography, intergrating the expilayer with other materials , very complex devices can be obtained. As one of the pioneer paper [4] has pointed out, an idea entangle-photon-pair source need to meet four demands: (i) deterministic generation, (ii) high fidelity, (iii) Indistinguishability, and (iv) high collection efficiency. On one of the recent paper, GaAs QD system has already been proved as comparable or even better system than InAs for emitting (ii) high fidelity and (iii) high indistinguishability entangled photon pairs. [1] Profit from the excellent nature of making complex and compact device, GaAs QD system may also achieve the goals of (i) deterministic generation and (iv) high collection efficiency in the very near future.

In this work, I will introduce several devices based on GaAs/AlGaAs QDs aimed at achieving bright emission and electrical control. [5]

Reference

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*Contact: huiying.huang@jku.at