Tunable $GaAs_xP_{1-x}$ Quantum-Dot Emission in Wurtzite GaP Nanowires

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Quantum light emitters can be realized by employing semiconductor quantum-dots (QD) for advanced quantum optics and nanophotonic applications. Tunable Gallium Arsenide Phosphide ($GaAs_xP_{1-x}$) QD in nanowires (NWs) with emission in VIS-NIR wavelength range have a strong technological potential. Here, we synthesized crystal-pure wurtzite Gallium Phosphide (GaP) nanowires (NWs), incorporating single $GaAs_xP_{1-x}$ QDs of various As content with a great degree of control over the shape and composition of the ternary alloy QD. A well-defined confinement of the QD and the tunability of the emission wavelength are confirmed by low-temperature micro-photoluminescence (μ-PL) spectroscopy showing that the QD NW emission is dominated by a narrow peak whose energy shifts according to the As content of the QD: from ~650 nm (As = 70%) to ~720 nm (As = 90%) (see Fig. 1). Moreover, a localized and efficient carrier recombination mechanism is found by single-NW μ-PL mapping, confirming that this emission arises from the QD. Finally, a power and temperature dependent μ-PL study is performed to characterize the QD excitonic properties and to identify the origins and the nature of the involved energy levels [1].

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References

[1] Robert Andrei Sorodoc, Paolo De Vincenzi, Akant Sagar Sharma,, Giada Bucci, Mario Roggi, Enrico Mugnaioli, Lucia Sorba, Marta De Luca, and Valentina Zannier, Tunable GaAsxP1–x Quantum-Dot Emission in Wurtzite GaP Nanowires, ACS Applied Materials & Interfaces, in press DOI 10.1021/acsami.4c15343

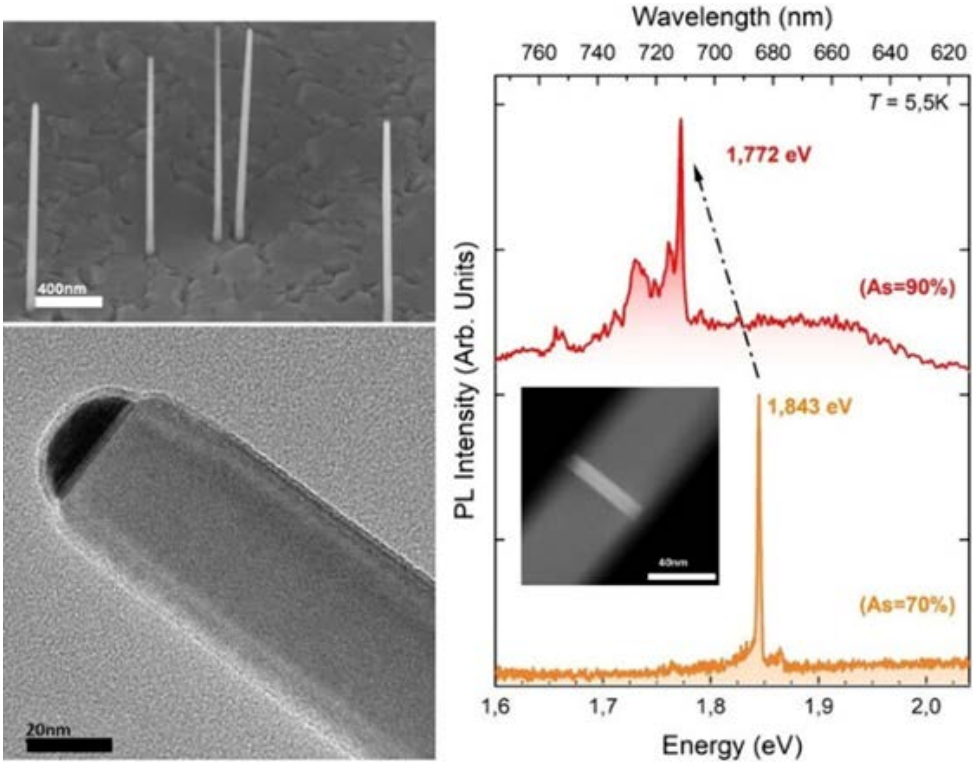

Fig.1 Scanning and transmission electron microscopy images (left side panels) and low-temperature μ-PL spectra (right side panel) of $GaAs_xP_{1-x}$ QD NWs with As = 70% and As = 90%.