

Innovative Aminophosphine-based Synthesis of InP Quantum Dots

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Monodisperse ensembles of colloidal quantum dots (QDs) feature a narrow, size-tunable emission spectrum in combination with a broad absorption and excitation spectrum and suitability for solution-based processing. This combination makes QDs emitting in the visible of particular interest for lighting and display applications. To make the use of QDs in these fields feasible, interest is shifting from the well-characterized Cd-based QDs to Cd-free alternatives such as InP QDs. The first synthesis of InP QDs with a reasonable size-dispersion was published in 1995.¹ This synthesis introduced tris(trimethylsilyl)phosphine which has remains also today the most widely used phosphorous precursor for InP QDs. However, this compound is problematic as it is highly expensive and inflames in contact with air.



We recently proposed protocols based on aminophosphine-type precursors that allow for a cost efficient, up-scaled syntheses of InP QDs of different sizes.² This precursor is considerably cheap and is safe-to-use under ambient. We have demonstrated that the reactions can attain a close to full yield conversion (with respect to the indium precursor) and we demonstrate that size tuning at full chemical yield is possible by changing the nature of the indium precursor. ZnS and ZnSe shell growth procedures can be used to make core/shell QDs with excellent emission properties: a narrow (45-60 nm FWHM) photoluminescence tunable from 480 nm to 670 nm and a quantum yield ranging from 30-80 %.² We also present a complete investigation of chemical reactions leading to the formation of InP starting from aminophosphine-type precursors. This mechanism is innovative as it points out a double role of the phosphorus precursor in the reaction as both a reducing agent and the source of the phosphorous needed to form InP. Its understanding will further the use of aminophosphines for the synthesis of III-V QDs.

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