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III-V Semiconductor Quantum Dots – Plasma-related controls
AMANDA RIDER, The University of Sydney, KOSTYA OSTRIKOV, CSIRO, IGOR LEVCHENKO, EUGENE TAM, The University of Sydney, PLASMA NANOSCIENCE TEAM — Binary and ternary III-V semiconductor materials are of great interest for a range of applications. The ability to precisely tailor optoelectronic properties is required for widespread technological implementation of III-V quantum dots (QDs) – this may be achieved through a deterministic level of control over QD size, composition and internal structure during the initial stages of growth. The aim of this paper is to achieve a stoichiometric QD composition at the earliest possible time and to elucidate the benefits of conducting QD growth in a plasma environment. To that end, binary and ternary III-V QD growth is simulated in both neutral- and ionized- gas environments. The impact of using plasma/ion-related effects (via ionizing a portion of the influx and the presence of an Ar background plasma) is taken into account by including substrate heating and a reduction in surface diffusion activation energy. Incorporating plasma-related tools at the beginning of growth affords many advantages – in this work, however, we are predominantly interested in the smaller stoichiometrization times and thus more homogeneous QDs.

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