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The appearance of localized resonances above the continuum in quantum dots¹ VOICU POPESCU, National Renewable Energy Lab, Golden CO, GABRIEL BESTER, Max Planck Institute for Solid State Research, Stuttgart, Germany, ALEX ZUNGER, National Renewable Energy Lab, Golden CO — We investigate the nature of hole and electron states in self-assembled InAs/GaAs and (In,Ga)As quantum dots, using a multi-band atomistic pseudopotential approach. We offer a classification of both hole and electron states based on an analysis of their localization both in the z and xy -directions. We show that the coherent dot-matrix strain present in self-assembled quantum dots distorts the electron confining potential, creating “wings” in the vicinity of the dot. This results in the appearance of dot-confined electronic states that lie above the continuum of the matrix material. The spectroscopic manifestation of these resonant states is investigated, by calculating the inter-band as well as the intra-band absorption spectra. We find, in both cases, that clear finger-prints of the resonances appear, in the form of sharp, well-defined peaks. In contrast, the previously suggested “cross-transitions” between wetting-layer states and dot states are shown to disappear once realistic strain is included.

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Voicu Popescu
National Renewable Energy Lab, Golden CO

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