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Effect of Atomic-Scale Alloy Randomness on the Optical Polarization of Semiconductor Quantum Dots[1] VLADAN MLINAR, ALEX ZUNGER, National Renewable Energy Lab., Golden, CO 80401 — Alloyed $Ga_{1-x}In_xAs$ system consists of different random assignments σ of the Ga and In atoms to the cation sublattice sites; each configuration having, in principle, distinct physical properties. For self-assembled dots made of finite number of cations ($\leq 10^5$), self-averaging of configurations may not be complete, so single-dot spectroscopy can observe the atomic-scale alloy randomness effects. We examine the effect of such atomic-scale randomness on the fine structure-splitting (FSS) of the exciton observed via the polarization anisotropy of its components. We find: (i) The FSS of the monoexciton X^0 changes by more than a factor of 7 with σ. Thus, finite nanostructure systems provide clear evidence for the effects of atomic-scale randomness on physical properties. (ii) The polarization anisotropy of two X^0 transitions is affected both by σ variations and from possible QD base elongation. Thus, the polarization anisotropy cannot be used as a measure of geometrical anisotropy alone, (iii) Polarization directions of different multiexciton emission lines are determined by σ.

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