Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

**Heavy-hole light-hole mixing mechanisms and optical polarization in semiconductor QDs** ALEX ZUNGER, CU Boulder, USA, GABRIEL BESTER, Max-Planck-Institut für Festkörperforschung, Germany, JUN-WEI LUO, NREL, USA — The symmetry of epitaxially grown semiconductor QDs was often overestimated to be $D_{2d}$ in which case the [110] and [1-10] directions are equivalent. Under $D_{2d}$ symmetry the underlying bulk HH and LH states belong to two different irreducible representations, $\Gamma_7$ and $\Gamma_6$ respectively, forbidding HH-LH mixing. Experimentally found HH-LH mixing in strained InAs/GaAs QDs was attributed to symmetry breaking induced by strain. In strain-free GaAs/AlGaAs QDs, one expects such HH-LH mixing to be vanishing. However, the HH-LH mixing experimentally observed in strain-free GaAs/AlGaAs QDs is comparable with the one observed in strained InAs/GaAs QDs. The origin of this mixing was assumed to originate from dot shape anisotropy. Using the atomistic pseudopotential method we find that the HH-LH mixing exists even in overall shape symmetric strain-free GaAs/AlGaAs QDs with a magnitude even larger than in the case of strained InAs/GaAs QDs. We will analyze the relative importance of the following mechanisms: (i) the intrinsic nonequivalence of the [110] and [1-10] directions, which lowers the QDs symmetry to $C_{2v}$; (ii) shape anisotropy induced symmetry breaking; (iii) built-in non-uniform strain; (iv) alloying effects in either dot material or dot barrier, and (v) $C_{2v}$ interfaces in QDs. We also demonstrated that the intrinsic crystal induced optical anisotropy could be washed out by other factors, such as dot shape anisotropy, which indicates that HH-LH mixing is not the only mechanism responsible for optical anisotropy.

Jun-Wei Luo
National Renewable Energy Laboratory

Date submitted: 22 Jan 2013 Electronic form version 1.4