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Influence of Surface Reconstruction on Droplet Epitaxy of InAs/GaAs Quantum Dots for Photovoltaics[1] SIMON HUANG, LARRY AAGESEN, JINYOUNG HWANG, ALAN TERAN, JAMIE PHILLIPS, ROY CLARKE, KATSUYO THORNTON, RACHEL GOLDMAN, University of Michigan, Ann Arbor — Quantum dot (QD) superlattices have been proposed for improving solar cell efficiency by providing intermediate energy bands to allow sub-bandgap photon absorption. Although photocurrent enhancement from QD solar cells has been demonstrated, QD cells exhibit lower open-circuit voltages and efficiencies than the GaAs reference cells, presumably due to the high electron capture rates induced by the elliptically shaped Stranski-Krastanov QDs. To improve the QD aspect ratio, thereby reducing the electron capture rate, we are exploring an alternative QD fabrication approach, droplet epitaxy (DE). To date, we have explored the influence of buffer surface reconstructions on the In exposure dependence of DE QD densities and size distributions. The GaAs (1x1) surfaces lead to higher density of smaller QDs with broad log-normal size distributions, suggesting coalescence dominated QD growth with inhibited In atomic surface diffusion. The c(4x4) surfaces enable the formation of larger QDs with lower density and narrow Gaussian size distributions, suggesting Ostwald ripening dominated growth with enhanced In atomic surface diffusion. Furthermore, we will discuss correlations between the formation, interface structure, and photovoltaic properties of DE QDs.

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