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Interface roughness and valley manipulation in quantum dots DIMITRIE CULCER, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park MD 20742-4111, XUEDONG HU, Department of Physics, University at Buffalo, SUNY, Buffalo, NY 14260-1500, S. DAS SARMA, Condensed Matter Theory Center, Department of Physics, University of Maryland, College Park MD 20742-4111 — We present a systematic study of interface roughness and its role in enabling intervalley tunneling in coherent dynamical processes in quantum dots. The interface potential lifts the degeneracy of the lowest energy valleys and yields a set of valley eigenstates. Transitions between these valley eigenstates can take place in dynamics involving two or more dots. We demonstrate that interface roughness provides a mechanism to mediate interdot intervalley transitions and analyze the way this occurs in the dynamics of one and two electrons in a double quantum dot. Based on a simple theoretical model of the interface we derive an expression for the intervalley tunneling matrix element, and discuss the principal factors affecting its magnitude. We demonstrate that experimentally interdot intervalley transitions can be induced by appropriate manipulation of the bias between two dots and can be detected by charge sensing. We discuss further a method involving resonant tunneling for extracting additional information on intervalley tunneling and identifying valley-split states. This work was supported by LPS-NSA-CMTC.

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