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Hole spins in quantum dot molecules: control with random alloy GaBiAs barriers[1] ARTHUR LIN, Univ of Maryland-College Park, MATTHEW DOTY, University of Delaware, GARNETT BRYANT, National Institute of Standards and Technology — Quantum dot molecules (QDM) created by vertically stacking two semiconductor quantum dots (QD) have a tunneling barrier between the two dots which can be used to control hole spin, providing a promising candidate for qubits and qubit control. Interdot barriers of low Bi concentration GaBiAs can provide enhanced control of hole spins, by lowering the tunneling barrier for the holes without affecting conduction electrons or split off bands. We use atomistic tight-binding theory for InAs QDMs surrounded by an interdot barrier of GaAs with a GaBiAs layer inserted between the QDs, treating the GaBiAs as a random alloy in order to probe how the configurations of Bi atoms affect the overall behavior of the holes. We present results for electron and hole energies, as well as g-factor modification under applied vertical electric field, and hole spin-mixing to demonstrate how the thickness, location and Bi concentration of the GaBiAs layer modifies hole-spin physics in QDMs. We contrast the results obtained here for a GaBiAs layer treated as a random alloy with previous results obtained with a virtual crystal approximation for GaBiAs. We also discuss the sensitivity of the hole spin-mixing to different realizations of the random alloy.

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