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Hole spins in quantum dot molecules: novel tuning by GaBiAs barriers JACKSON FLOWERS, GARNETT BRYANT, National Institute of Standards and Technology, MATTHEW DOTY, University of Delaware — Hole spins in semiconductor quantum dots (QD) are promising qubits. Tunneling in vertical quantum dot molecules (QDM) provides additional freedom to use fields to manipulate hole g-factors and induce spin mixing. Interdot barriers made from GaBiAs should provide novel opportunities to further engineer these hole spin properties, because heavy- and light-holes in GaBiAs are modified by the Bi concentration without affecting conduction electrons or split off bands. For low Bi concentrations, GaBiAs provides a lower barrier for hole tunneling, allowing hole tunneling more comparable to electron tunneling and enhancing opportunities for g-factor modification. We use atomistic tight-binding theory for InAs QDMs with GaBiAs in the interdot barrier to assess the utility of this barrier material. We model the alloy barrier regions both with the virtual crystal approximation and with random realizations of atomic configurations for the alloy region in the barrier. Results are presented for electron and hole energies in QDMs with GaBiAs barriers as a function of applied electric and magnetic fields. These results allow us to quantify g-factor modification and hole-spin mixing in asymmetric structures to show how different GaBiAs barrier configurations modify hole spin physics in QDMs.

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