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Stark effect in type-II Ge/Si quantum dots

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Photocurrent spectroscopy was employed to study interband optical transitions and the quantum-confined Stark effect in an array of Ge/Si self-assembled quantum dots. The mean diameter and height of the Ge nanoclusters are about 6 nm and 4 nm, respectively. Under an applied electric field splitting of the exciton ground state is observed, implying that the dots possess two permanent dipole moments of opposite sign. We argue that the two possible orientations of the electron-hole dipole in each Ge dot are the result of the spatial separation of electrons which can be excited in Si as well as on top and below the Ge nanocluster. The separation of electron and hole is determined to be (5.1±0.2) nm for the top (apex) electron and (0.8±0.3) nm for the bottom (base) electron, yielding a distance between the electrons of (5.9±0.5) nm, which is consistent with the staggered band lineup inherent to type-II quantum dots. An external quantum efficiency of 1% at a telecommunication wavelength 1.3 μm was obtained for a *p-i-n* structure.

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