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Direct observation of the symmetry of core states of a single Fe impurity in GaAs JUANITA BOCQUEL, Eindhoven University of Technology, VICTORIA KORTAN, University of Iowa, RICHARD CAMPION, BRYAN GALLAGHER, University of Nottingham, MICHAEL E. FLATTÉ, University of Iowa, PAUL KOENRAAD, Eindhoven University of Technology — We report the observation of the two mid-gap core d-states of differing symmetry for a single Fe atom embedded in GaAs by scanning tunneling microscopy. By voltage control we can manipulate the charge state (Fe3+ or Fe2+) of the embedded Fe atom. For Fe in the Fe3+ state two different deep core d-states with E and T2 symmetry are distinguished by the strength of their hybridization with the surrounding host electronic structure. The mid-gap state of Fe that does not hybridize via sigma-bonding is strongly localized to the Fe atom, whereas the mid-gap state that does hybridize via sigma-bonding is extended, and comparable in size to other acceptor states measured previously. Tight-binding calculations of these mid-gap states agree with the measurements, and illustrate that such measurements can determine the degree of hybridization via pi-bonding of impurity d-states. In addition to fundamental probing of mid-gap d-state electronic structure, measurements of such intrinsically spin-orbit-entangled, single-dopant states may be of use for high-speed electrical control of single spins.

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