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An updated model for muonium in 6H-SiC

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We present an updated model for muonium properties and behavior in silicon carbide (polytype 6H; SiC) based on new (unpublished) and published results from our group's TF-, LF-, RF- and photoexcited MuSR measurements.

SiC is known and widely used for structural ceramics due to its physical properties (e.g. high thermal conductivity; hardness; strength; resistance to corrosion and abrasion) all being stable to near ~1920 K. The electrical and optical properties (E_G ~3.0 eV, for 6H-SiC) of SiC are of great interest to the device community as, for example, its electrical resistivity can be tuned from high resistivity (intrinsic) to a more conductive variety via p− or n− type doping. Isolated hydrogen impurities in semiconductors is an unavoidable, abundant and electrically active impurity in many materials. Direct study of isolated hydrogen impurities in semiconductors is not generally possible due to hydrogen's high reactivity or solubility limitations within the host; however, muonium is an experimentally accessible analogue allowing for an investigation into the stability and dynamics of these impurity centers.

One of the most popular polytypes of SiC is a 6 layer, hexagonal (Wurtzite; 6H-SiC). In this polytype, T-sites with Si neighbors at the end of a short-c axis have estimated hyperfine constants of 3009.5 MHz (Mu1) and 3026 MHz (Mu1b). A Si antibonding site has an estimated hyperfine constant of 2768 MHz (Mu2). A carbon antibonding site is identified with an estimated hyperfine constant of 2801 MHz (Mu3). Donor and acceptor levels were initially estimated based on thermal ionization; later, laser-based measurements identified possible ionization energies with some of these states. LF- and RF- MuSR has been completed to develop the most complete available characterization of muonium states in 6H-SiC.

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