

Study of μ^+ Localization and Diffusion in Sc and ScH_{0.05}*

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The location and diffusion of positive muons in single crystal samples of Sc and ScH_{0.05} have been studied. Low temperature results clearly show that, as in the case of hydrogen, the muons occupy the tetrahedral sites in the hcp lattice and produce a slightly anisotropic local expansion of the surrounding metal atoms. At higher temperatures motional narrowing is observed due to the onset of μ^+ diffusion and the deduced correlation times follow an Arrhenius behaviour above 100 K. The corresponding activation energies are 0.025 eV for Sc and 0.054 eV for ScH_{0.05}. A significant deviation from Arrhenius behaviour was observed for the ScH_{0.05} sample below 100 K and may be related to muon trapping by H.

1. Introduction

The recent discovery of quantum effects associated with the diffusion of H in scandium and yttrium [1–3] has led us to study the behaviour of muons in these metals since such effects should be more readily observable for the muon whose mass is approximately nine times smaller than that of the proton. In the case of H two distinct kinds of motion have been observed. Long range diffusion involves hops between tetrahedral (T) sites via a neighbouring octahedral site and rather slow hopping rates are observed ($\sim 10^4 \text{ s}^{-1}$ at 300 K) with activation energies of the order of 0.57 eV [4]. On the other hand a fast localised motion between neighbouring T sites has been observed by neutron scattering with hopping rates exceeding 10^{10}

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