

Polymorphic phase transformation in In_2La

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The nuclear quadrupole interaction of ^{111}Cd probes in In_2La was measured using perturbed angular correlation of gamma rays (PAC). At 11°C a unique quadrupole interaction was observed with $\omega_0 = eQV_{zz}/\hbar = 78.8(2)$ Mrad/s and $\eta = 0.312(1)$. At high temperature, this non-axially symmetric interaction is replaced by a quadrupole interaction having $\omega_0 = 101.0(1)$ Mrad/s at 500°C that is axially symmetric ($\eta = 0$). Figure 1 shows PAC spectra measured at 11°C (a), 250°C , where the two interactions coexist (b), and 500°C (c). The change in quadrupole interaction exhibits hysteresis extending over $100\text{--}200^\circ\text{C}$ but is otherwise reversible (see Fig. 2). It is attributed to a polymorphic or structural phase transformation.

In_2La has the CeCu_2 structure at room temperature [O.D. McMasters, K.A. Geschneider, Jr., *J. Less-Common Metals* **38** (1974) 137], for which there is a unique indium site having $m..$ point symmetry. Due to the low symmetry, the electric field gradient should have a nonzero value of η , as observed at ambient temperature. No high-temperature phase has been reported in the literature. Attempts to determine the structure of the high-temperature phase by x-ray diffraction failed due to extremely rapid out-diffusion and oxidation of La. However, the phase remained stable for weeks in our PAC oven under a pressure of $5 \mu\text{Pa}$.

We propose that the high-temperature phase has the AlB_2 (C32) structure based on previous observations of such a polymorphic transformation in Ag_2Pr and Ag_2Nd [A.M. Mulokozi et al., *J. Less-Common Metals* **57** (1978) 39]. The In-site in the AlB_2 structure has hexagonal symmetry so that $\eta = 0$, as observed. Thus, hyperfine interaction methods can help discover polymorphic phase transformations.

Keywords: *polymorphic phase transformation, quadrupole interaction, PAC*

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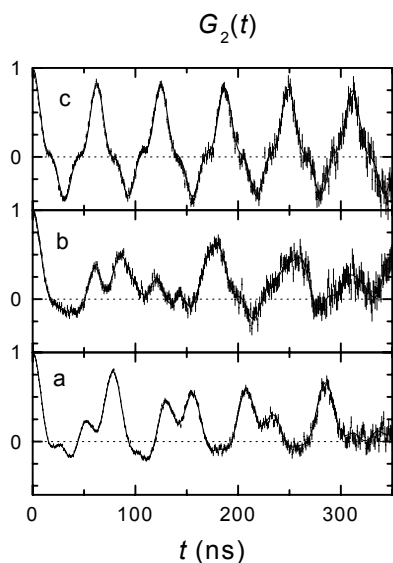


Figure 1: PAC spectra of In_2La at (a) 11°C , (b) 250°C and (c) 500°C .

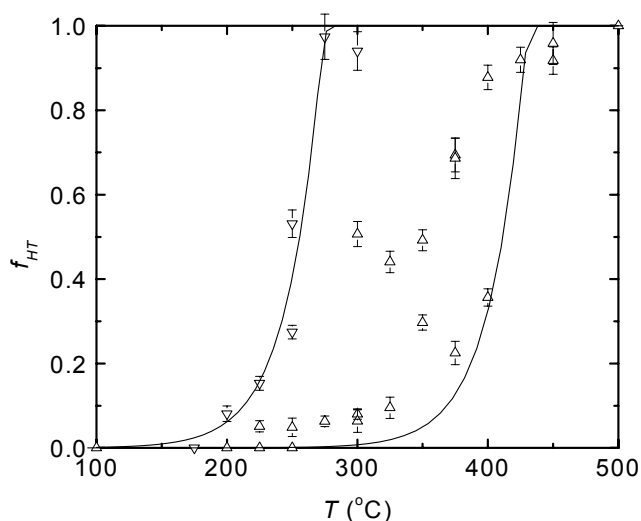


Figure 2: Volume fraction of the high-temperature phase of In_2La obtained from measured site fractions.