Zeitschrift: Helvetica Physica Acta
Band: 62 (1989)
Heft: 6-7

Artikel: NMR study of martensitic transformation in a Cu-Zn-Al alloy
Autor: Rubini, S. / Dimitropoulos, C. / Borsa, F.
DOI: https://doi.org/10.5169/seals-116093

NMR STUDY OF MARTENSITIC TRANSFORMATION IN A Cu-Zn-Al ALLOY

S. Rubini*, C. Dimitropoulos*, F. Borsa**, R. Gotthardt***

*Institut de Physique Expérimentale, *** Institut de Génie Atomique, EPF-Lausanne, CH-1015 Lausanne, Switzerland
** Dept of Physics "A. Volta", University of Pavia, I-27100 Pavia Italy

Abstract : ^{27}Al and ^{63}Cu NMR spectra and relaxation rates have been investigated in a Cu-Zn-Al alloy displaying a martensitic transformation just below room temperature. The results show changes in the parameters which are discussed in terms of electronic changes and lattice instabilities.

1. Introduction

The martensitic transformation in Cu-Zn-Al alloys is a displacive structural change from a cubic (high T, austenite) to a monoclinic (low T, martensite) structure. Anomalies in various physical parameters **[1]** are present in a region of about 30 K above the conventional transition point. A general microscopic description of the phase transition is still lacking.

^{27}Al and ^{63}Cu nuclei are microscopic probes sensitive to the local equilibrium electronic environment through their NMR spectrum and to critical fluctuations through their relaxation rates **[2]**.

2. Results and discussion

The experimental conditions are described in **[3]**.The ^{63}Cu NMR spectrum shows a field dependent doublet (30 kHz at 7 Tesla) in the austenitic phase indicative of two Cu sites with different local electronic environment. The doublet evolves into a single broad line ($\Delta\nu \cong 60$ kHz) in the martensite.

The ^{27}Al spectrum is the same in both phases and it consists of a central narrow line and a broad ($\pm$ 100 kHz) symmetric one due to a distribution of quadrupole satellites transitions, indicating the existence of local distortion around the Al site, dominated by the atomic disorder.

The ^{27}Al Knight shift changes abruptly at the transition (see Fig. 1). This indicates that the local electronic density at the Fermi surface, around the Al nuclei is higher in martensite than in austenite. A similar change in Knight shift is observed for one of the two lines of the ^{63}Cu doublet. The Al and Cu spin-lattice relaxation rates shown in Fig. 2 display a broad BPP-type maximum which can be explained in terms of a thermally activated diffusive motion with an activation energy of the order of 1200 K (0.1 eV) **[1]**, and the sharp peak in T_1^{-1} observed around the phase transformation is indicative of critical fluctuations associated with electronic charge instability rather then lattice phonon instability.

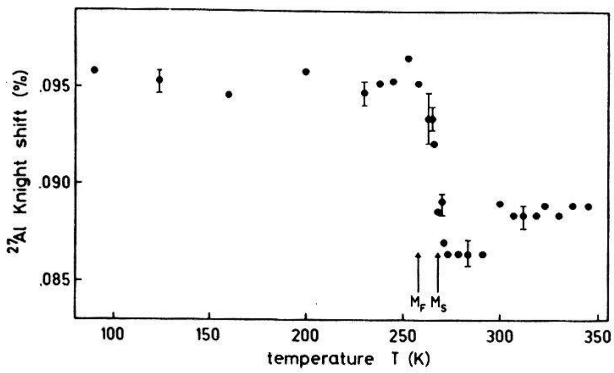

Fig. 1 : Temperature dependence of the ^{27}Al Knight shift.

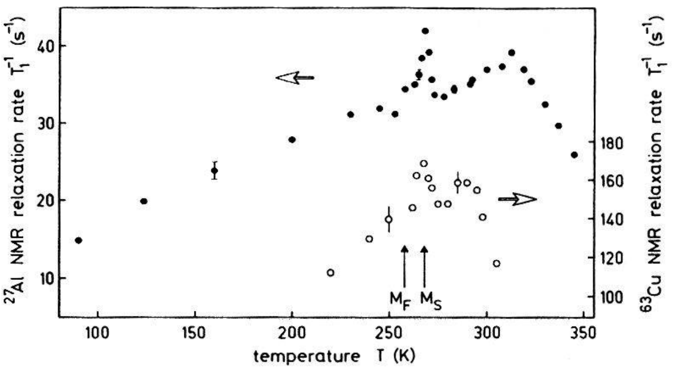

Fig. 2 : Temperature dependence of ^{27}Al and ^{63}Cu spin-lattice relaxation rate.

This work has been supported partially by the "Fonds National Suisse de la recherche scientifique". We thank J.J. van der Klink for many stimulating discussions.

References

[1] R. Gotthardt, C. Dimitropoulos : Phase Transformations '87, Ed. G.W. Lorimer, the Institute of Metals (1988).

[2] A. Rigamonti : Adv. in Physics 33 (1984) 115.

[3] S. Rubini, C. Dimitropoulos and R. Gotthardt, Proc. of the Europ. Conf. the Martensitic Transformation in Science and Technology (1989), in press.