Applied Surface Science 50 (1991) 154–158
North-Holland

Characterization of Cd implanted and annealed GaAs and InP by perturbed angular correlation (PAC) spectroscopy

W. Pfeiffer, M. Deicher, R. Keller, R. Magerle, P. Pross, H. Skudlik
Fakultät für Physik, Universität Konstanz, W-7750 Konstanz, Germany

Th. Wichert, H. Wolf
Technische Physik, Universität des Saarlandes, W-6600 Saarbrücken, Germany

D. Forkel
EP Division and ISOLDE Collaboration CERN, CH-1211 Geneva 23, Switzerland

N. Moriya and R. Kalish
Physics Department and Solid State Institute, Technion, Haifa 32000, Israel

Received 27 November 1990; accepted for publication 14 January 1991

Investigations of ^{111m}Cd implanted GaAs and InP crystals using the microscopically sensitive perturbed angular correlation technique show that the implanted Cd is incorporated on unperturbed substitutional lattice sites during rapid thermal annealing at significant lower temperatures than for electrical activation is required. In GaAs the higher implantation temperature at 473 K did not show any influence on this annealing stage, whereas a higher implantation dose hinders the annealing. We conclude that not only the local environment of the implant but also the long-range lattice perfection has to be restored for the electrical activation of implants in III–V compound semiconductors.

1. Introduction

The knowledge about electrical activation of implanted dopants in compound semiconductors is of interest, both, in technical application of ion implantation for device production and with respect to an improvement of the basic understanding of defects in these systems. Whereas different annealing and implantation conditions have been intensively studied in GaAs [1], the microscopic processes finally leading to electrical activation of the dopants are not yet understood. The proposed model, that for the electrical activation of p-type dopants in GaAs the incorporation on substitutional lattice sites alone is sufficient [2] is in contradiction to emission channeling results, which report incorporation on substitutional sites already at 300 K [3]. It was proposed that microscopic processes, especially the interaction of the implanted acceptor atoms with point defects being already present in GaAs or created during implantation, are responsible for the reduced efficiency of electrical activation achieved during annealing [1]. Therefore, the microscopically sensitive perturbed angular correlation (PAC) technique using the probe atom ^{111m}Cd is appropriate to investi-