

Lattice location of the transition metals Co and Ni in Si

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We have studied the lattice location of the transition metals ^{61}Co (1.6 h) and ^{65}Ni (2.5 h) in Si single crystals of various doping types by means of on-line Emission Channeling using Short-Lived Isotopes (IS453 EC-SLI). ^{65}Ni was directly obtained by means of Ni RLLIS ionization, while for the ^{61}Co experiments we implanted the short-lived precursor isotope ^{61}Mn (4.6 s) which decays via ^{61}Fe (6 min) to ^{61}Co , during the Mn RLLIS run. In this case only measurements after a waiting period of 30 min were considered.

The samples were low-doped n-Si (7.3-12 Ohm cm, in the following named i-Si), as well as highly p+ (0.0053 Ohm cm) and n+ (0.0030 Ohm cm) doped Si.

While full quantitative analysis of the measured EC-SLI patterns by means of fitting to the results of manybeam simulations of emitter atoms on various lattice sites has not yet been performed, a qualitative inspection gave the following preliminary results.

Directly after room temperature implantation, the major lattice sites occupied by ^{61}Co and ^{65}Ni were substitutional or near-substitutional sites in all doping types studied.

However, after annealing at 500°C ^{65}Ni changed to tetrahedral interstitial (T) sites in i-Si and p+-Si, while the majority of ^{65}Ni in n+-Si was found on bond-centered (BC) interstitial sites after the same annealing temperature.

Site changes to interstitial T sites were also observed for ^{61}Co in i-Si and p+-Si, while the case of ^{61}Co in n+-Si is still waiting to be measured at next year's Mn beam time.

The behaviour of Co and Ni in Si shows hence some similarities to Fe in i-Si, where site changes from near-S to T sites were already observed in previous

experiments. However, there are also clear differences. While the site changes S->T in the case of Ni and Co occurred already after annealing at 475-500°C, in the case of Fe in i-Si around 600°C was required in order to promote the corresponding effect.

Also, while Fe showed considerable resistance against high-temperature annealing, which went along with the occupation of ideal substitutional sites after 900°C annealing, Co and Ni started to show partial out-diffusion from the samples already for annealing temperatures in the 600-850°C range.

Primary author: Mr SILVA, Daniel (Universidade do Porto)

Co-authors: Prof. VANTOMME, André (Inst. voor Kern- en Stralingsfysica - KU Leuven); Mr BOSNE, Eric (Universidade do Aveiro); Prof. ESTEVES DE ARAUJO, Joao Pedro (Universidade do Porto Laboratorio de Fisica); Dr MARTINS CORREIA, João Guilherme (Instituto Tecnológico e Nuclear Sacavém); Mrs PINTO DE ALMEIDA AMORIM, Ligia (Inst. voor Kern- en Stralingsfysica - KU Leuven); Mr DA COSTA PEREIRA, Lino Miguel (Inst. voor Kern- en Stralingsfysica - KU Leuven); Prof. CASTRO RIBEIRO DA SILVA, Manuel (Instituto Superior Tecnico IST); Dr DECOSTER, Stefan (Inst. voor Kern- en Stralingsfysica - KU Leuven); Dr WAHL, Ulrich (Instituto Tecnológico e Nuclear Sacavém)

Presenter: Mr SILVA, Daniel (Universidade do Porto)

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