Lattice location of the transition metals Mn, Co and Ni in Si

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Silicon has been the most used material in today's semiconductor industry. Monocrystaline Si Solar cells are a good example of its use, presenting efficiencies up to 10%. Although these efficiencies seem to be low, they can only be achieved after gettering procedures that consists on moving transition metal (TM) impurities away from the active area of the solar cell. The efficiency degradation by TMs occur due to the fact that TMs present deep levels within the bandgap of Si, creating recombination centers and, thus, acting as "lifetime killers" for minority carriers. These deep levels strongly depend on the occupied lattice site. Despite extensive research, many fundamental questions on TMs in Si still remain unanswered, among them detailed knowledge on their lattice sites, both in their isolated form and in complexes with other impurities or defects.

We have studied the lattice location of the transition metals ^{56}Mn (2.6 h), ^{61}Co (1.6 h) and ^{65}Ni (2.5 h) in Si single crystals of various doping types (n-Si, n^+-Si and p^+-Si) by means of on-line Emission Channeling (EC) using Short-Lived Isotopes obtained at ISOLDE facility (CERN). EC is a method that consists on doping single crystals with radioactive probe atoms that decay by the emission of beta particles, which, on their way out of the crystal, experience channeling effects along some crystal directions, depending on the lattice site occupied by the probe atom. Our results confirm the occupation of the three studied TMs in three different lattice sites (ideal substitutional, displaced substitutional and displaced tetrahedral interstitial sites). In this contribution the analysis of the lattice location of Mn, Co and Ni in Si will be presented.