Lattice location of deep level impurities in hyperdoped Si by ion implantation and short-time annealing

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Abstract:

Impurities play an important role in determining the electrical, optical and structural properties of semiconductors. It has been proposed that deep level impurities, such as Titanium (Ti) or chalcogens in Si, can induce an impurity band inside the bandgap at high enough doping concentration. The insertion of an impurity band can enhance the absorption at a broader wavelength range and leads to applications in the so-called intermediate band solar cell. However, deep level impurities have relatively low solid solubility limit in Si. We prepared deep level impurities doped silicon to above the Mott insulator concentration by ion implantation followed by sub-second annealing. The degree of crystalline lattice recovery in implanted layers and the lattice location of impurities in Si were analyzed by Rutherford backscattering spectrometry/Channeling. Our results show that S and Se atoms are occupying substitutional lattice sites in Si [1], while Ti impurities have no ordered lattice occupation [2].

[1] S. Zhou, F. Liu, S. Prucnal, *Sci. Rep.* **5,** 8329 (2015).
[2] F. Liu, et al., in preparation (2015).