Dopant mapping in InP nanowires for solar cell applications

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Nanowire solar cells are cheaper and consume less material than planar solar cells [1]. However, it is necessary to improve their performance in order to achieve competitive efficiencies. A nanowire solar cell is based on an array of nanowires doped as pn-junctions. At the pn-junction the electrical carriers (electrons and holes) created by light interacting with the nanowires are separated and thus electrical energy is generated.

Thus optimizing the pn-junction by controlling the dopant concentrations inside the nanowires is a crucial aspect to improve the performance of these nanowire solar cells. However, determining the dopant profile inside nanowires is challenging because of the small size of the nanowires. We use atom probe tomography (APT) to measure such concentration profiles [1]. APT enables us to map the atomic positions in a nanowire in three dimensions with sub-nm resolution [3].

We have examined Si (n-type) and Zn (p-type) doped InP nanowires using APT in order to extract the doping profiles from the nanowires with sensitivity down to the single digit ppm level. Here we present the sample preparation technique required to make these measurements, the doping profiles extracted from various nanowires and discuss the relations between nanowire shape and doping levels.

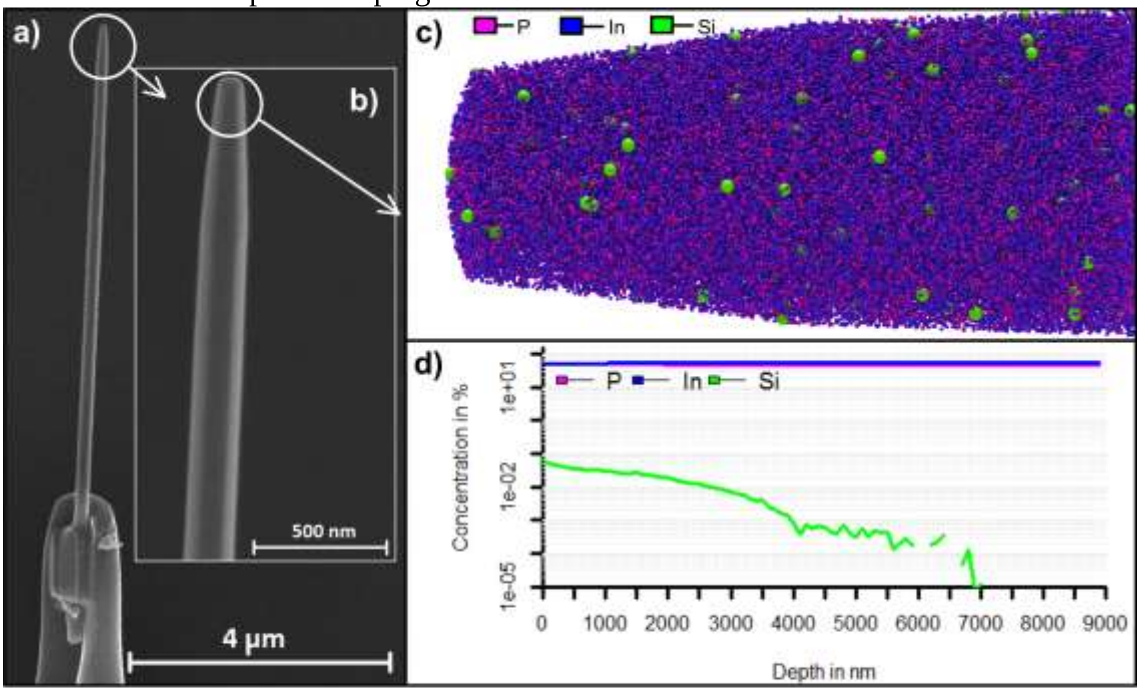

Figure 1: Si doped InP nanowire analysis results: a,b) SEM images, c) Atomic positions 3D reconstruction of 10% of the atoms, d) element concentration profiles

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