Spatially resolved doping profiles of *p-i-n* junctions in VLS-grown nanowires

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Controlled dopant profiles and abrupt electrical junctions are absolutely essential for the operation of current and future semiconductor devices. For example, one of the main challenges facing the fabrication process of nanowire (NW)-based electronics is the formation of well-defined dopant profiles which are crucial for the fine-tuning of the device behavior.

However, the conventional doping mechanism, where dopants are introduced *in-situ* during growth, results in both axial and radial inhomogeneous doping profiles. These stem from both a surface doping mechanism known as vapor-solid (VS) growth, and a certain anisotropy which is intrinsic to the vapor-liquid-solid (VLS) mechanism itself. Moreover, at interfaces between different doping types, a region of diffuse boundaries is formed rather than an abrupt transition between the two segments [1-5].

We present quantitative Kelvin probe force microscopy (KPFM) measurements of both the longitudinal and the radial doping distribution at the junction regions of *p-i-n* doped Si NWs (SiNWs). Coupled with electrical measurements and simulations, our findings shed light on the complex chemical structure of these wires. We find that the combination of the VLS and the VS mechanisms produce radial, as well as axial junctions on the wire surface.

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