Segregation behaviors and radial distribution of dopant atoms in silicon nanowires

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National Institute for Material Science, Japan Science and Technology Agency and University of Tsukuba announced on February 4, 2011 that they succeeded in detecting nondestructively dynamic behaviors of doped impurities in Si nanowires (Si NWs) coated by SiO2 to make surrounding gate field-effect transistors. Details were presented in *NANO Letters* of American Chemical Society.

Understanding the dynamic behaviors of dopant atoms in Si NWs is the key to realize low-power and high-speed transistors using Si NWs. The segregation behavior of boron (B) and phosphorus (P) atoms in B- and P-doped Si NWs (20 nm in diameter) during thermal oxidation was closely analyzed.

Local vibrational peaks and Fano broadening in optical phonon peaks of B-doped Si NWs were used to detect the behavior of B. Electron spin resonance (ESR) signals from conduction electrons were suitable means for P-doped Si NWs.

The radial distribution of P atoms in Si NWs was also investigated to prove the difference in segregation behaviors between of P and B atoms.

B atoms were found to segregate preferentially in the surface oxide layer, whereas P atoms tend to accumulate around the interface inside the Si nanowire.

In addition, segregation of B atoms was found to be suppressed by the

stress applied to Si NWs.

More information: Naoki Fukuda, Shinya Ishida, Shigeki Yokono, Ryo Takiguchi, Jun Chen, Takashi Sekiguchi, and Kouichi Murakami, "Segragation Behaviors and Radial Distribution of Dopant Atoms in Silicon Nanowires", *NANO Letters* (2011) doi: 10.1021/nl103773e Published online 24 January 2011.

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