Variable temperature conducting tip atomic force microscopy of cobalt silicide on n-type Si(111):7×7 and n-type Si(100):2×1

JOSEPH TEDESCO, J.E. (JACK) ROWE, North Carolina State University, ROBERT NE-MANICH, Arizona State University — Cobalt silicide (CoSi$_2$) nanoislands have been formed by ultrahigh vacuum deposition of thin films ($\sim 0.3 - 1.0 \pm 0.1$ nm) of cobalt on clean n-type Si(111) and n-type Si(100) surfaces followed by annealing to $\sim 900^\circ$C. Contact areas of the nanoislands were found to range from $\sim 50 \times 10^3 - 450 \times 10^3$ nm$^2$ when grown on Si(111) and from $\sim 100 \times 10^3 - 700 \times 10^3$ nm$^2$ when grown on Si(100). Conducting tip atomic force microscopy (c-AFM) has been used to record current-voltage (I-V) curves from the nanoislands at several temperatures between room temperature and $\sim -200^\circ$C. The I-V curves are analyzed using thermionic emission theory to determine the Schottky barrier height, $\Phi_B$, and the ideality factor, $n$, of the nanoislands. Room temperature values of $\Phi_B$ and $n$ are found to be in the range of 0.35 – 0.63 eV and 1.1 – 1.8, respectively. Comparisons of $\Phi_B$ and $n$ are performed for nanoislands of different shapes, and the temperature dependence of both $\Phi_B$ and $n$ is analyzed. Richardson plots for the nanoislands are created and found to be non-linear at low temperature. The nanoislands were etched off the silicon surface using ex situ hydrofluoric acid (HF) etching and AFM was used to examine the shape of the nanoisland-substrate interfaces, and nanoisland properties are that shape.

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Date submitted: 20 Aug 2007