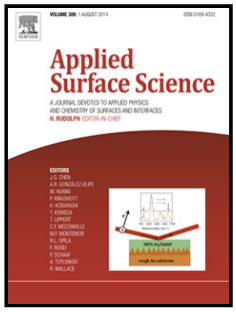

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Author: Zhiliang Wang Haihong Yin Yonghong Chen Xinglong Guo Xuefeng Zhang Changqing Song Jian Zhang

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The influence on magnetic property of Nickel nanoparticles deposited on the silicon nanowires arrays at low temperature

Zhiliang Wang[a, b], Haihong Yin[b,*], Yonghong Chen[a], Xinglong Guo[b], Xuefeng Zhang[b], Changqing Song[b], Jian Zhang[c,*]

[a] Xinglin College, Nantong University, 9 Seyuan road, Nantong 226019, China

[b] School of Electronics and Information, Nantong University, 9 Seyuan road, Nantong 226019, China

[c] Department of Electronic Engineering, Key Laboratory of Polar Materials and Devices (Ministry of Education of China), East China Normal University, 500 Dongchuan Road, Shanghai 200241, China

Abstract

There are a large number of paramagnetic defects on the surface of as-grown silicon nanowires (SiNWs) in contrast to H-terminated silicon (Si). Herein, SiNWs arrays were fabricated by chemical etching, Nickel nanoparticles (Ni NPs) were deposited on the surface of SiNWs arrays by the electroless plating. The influence of paramagnetic defects on the magnetic property of Ni/SiNWs was investigated and compared to Ni/Si. The paramagnetic defects of as-grown SiNWs and H-terminated Si were studied by ESR and FTIR spectra. The diameter distribution of Ni NPs on the surface of SiNWs arrays and Si was probed by SEM and fitted by the lognormal probability density function. The results reveal that the diameters of Ni NPs are 35.09 ± 0.53 and 34.92 ± 0.72 nm respectively. The magnetic properties of M-H hysteresis loops for Ni/SiNWs and Ni/Si were measured from 5 to 400 K. With the temperature increasing, the saturation magnetization of Ni/SiNWs and Ni/Si decreases gradually due to the thermal activation effect. Overall temperature range (5-400 K), the saturation magnetization of Ni/Si follows the modified Bloch's law. However, the data of Ni/SiNWs are only valid for high temperature range (50-400 K). At low temperature (5 K), there is an abrupt increase and the experimental data deviated from the modified Bloch model. This deviation at low temperature is associated with surface paramagnetic defects of SiNWs.

Keywords: silicon nanowires; Nickel nanoparticles; paramagnetic defects; saturation magnetization

* Corresponding author. Tel.: +862154345203; fax: +862154345119

E-mail address: yhh_nt@163.com (Haihong Yin); jzhang0002@gmail.com (Jian Zhang)