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単層 Si ナノシートの作製と電子輸送特性評価

Electron Transport Properties of Single-layer Si Nanosheets Fabricated by Soft Chemical Synthetic Method

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Two-dimensional nanostructures such as graphene and semiconductor nanosheets (NSs) are expected to be utilized as building blocks for future nano electronic devices such as sensors, solar cells, and batteries because of their intriguing physical and chemical properties. From the viewpoint of applications, Si-based NSs should have a high affinity for planar integrated circuits. We recently developed a fabrication method of single-layer Si NSs covered with *n*-decylamine[1]. Before they can be used in the above-mentioned applications, it is critical to determine the fundamental electronic properties of Si NSs. In this study, we investigated the electron transport properties of the single-layer Si NSs using atomic force microscopy (AFM) equipped with a conductive cantilever[2].

After the single-layer Si NSs were confirmed to be dispersed on a highly-oriented pyrolytic graphite substrate as shown in Fig.1(a), the *I-V* characteristics of NSs were measured using the conductive cantilever. Based on an arbitrary tunnel barrier within the Simmons approximation[3], which is the simplest way to model the *I-V* curves of a metal-insulator-metal system, the obtained *I-V* curves were analyzed. Consequently, we found that the electron transport mechanism in the single-layer Si NSs covered with *n*-decylamine is based on nonresonant tunneling. At applied voltages less than V_{trans}, direct tunneling was dominant, whereas Fowler-Nordheim tunneling was dominant at voltages greater than V_{trans} (Fig.1(b) and (c)). This value is smaller than that of alkane molecules, indicating that the barrier height ϕ of the Si NSs is smaller than that of the molecule.

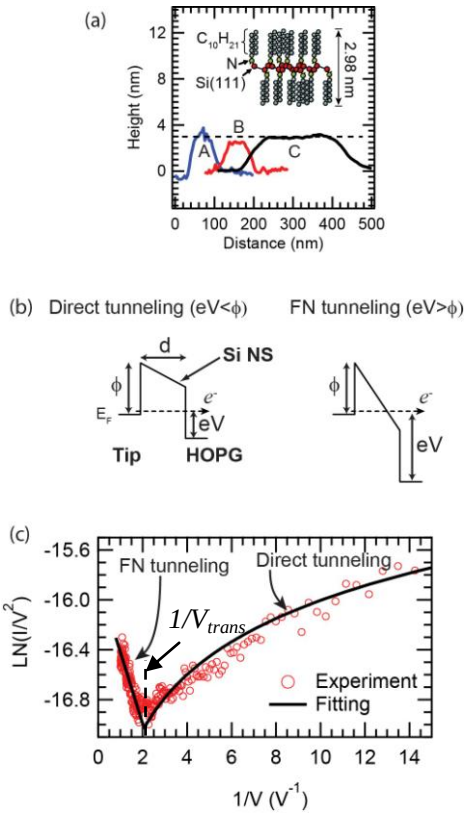

Figure 1(a) Line profiles of the height of the NSs. Inset: Schematic illustration of single-layer Si NS, (b) Schematic illustrations of the barrier shapes corresponding to direct tunneling and Fowler-Nordheim (F-N) tunneling, respectively. (c) F-N plot of Si NS.

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