28a-B9-5

Thermoelectricity in Ni Nanocontact

Graduate School of Engineering Science, Osaka University, Toyonaka, Japan

[D] **See Kei Lee, Ryo Yamada and Hirokazu Tada**

E-mail: seekei@molectronics.jp

Studies on thermoelectric effects (TE) in atomic and molecular junctions have attracted much attention since their thermoelectric efficiency is expected to increase due to the narrow energy distribution of electrons participating in the transport process [1,2]. Seebeck coefficient (S) of the atomic and molecular junctions is expressed as a function of dT/dE, where T and E represent transmission function and energy, respectively [1]. When the transport is through fully opened conduction channel, i.e., resonance transport or ballistic transport with quantum conductance is realized, S = 0. This phenomenon was experimentally observed for point contact of gold, silver and copper [3]. It is also reported that the S is sensitive to tiny differences of the structure of the junction and can be scattered in both negative and positive values.

In this work, we investigate S of Ni point contact. Conduction through nickel (Ni) point contact is known to be composed of mixture of partially opened multiple channels [4], which is difficult to be confirmed only from the conductance measurement. S is expected to give fruitful information on the structure of the transport channel. In addition to the analysis of transport channel, realization of large S is also expected.

In our experiment, we measured the thermoelectric voltage (TEV) of Ni atomic contacts with a scanning tunnelling microscope. The difference in temperature between the tip and the substrate, ΔT, was given by heating the substrate with a Peltier device. Temperatures of the tip and substrate were monitored by Si diode sensors. The Ni tip was brought close to the Ni thin film substrate until a threshold current value was reached, and then, the voltage difference between the tip and the substrate was measured during the retraction of the tip.

Figures 1(a) and 1(b) show the voltage histogram observed when the tip was held at the conductance of 2.5 G_0 ($G_0 = 2e^2/h$) and 1.2 G_0, respectively, at ΔT = 4.5 K. Whereas a single sharp peak was observed for the histogram at the conductance of 2.5 G_0, multiple peaks were observed at the conductance of 1.2 G_0, as indicated by the arrows. The observation of non-zero S value indicates 1.2 G_0 is realized by mixture of the conduction channels which was not full resonance [4]. This may coincides with theoretical investigations. The presence of multiple peaks indicates the existence of different atomistic structure.

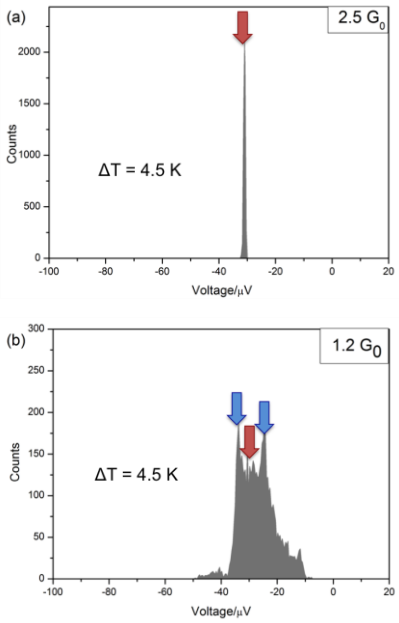

Figure 1: Voltage histogram for Ni atomic contacts at (a) 2.5 G_0 and (b) 1.2 G_0 at ΔT = 4.5 K.

1. J. A. Malena, S. K. Yee, A. Majumdar, R. A. Segalman, Chemical Physics Letters 491, 109-122 (2010).

2. G. D. Mahan and J. O. Sofo, Proc. Nat. Acad. Sci. USA 93 (15) 7436. (1996).

3. B. Ludoph and J. M. van Ruitenbeek, Phys. Rev. B 59, 12290 (1999).

4. . F. Pauly, M. DreherJ, M. Häfner, J. C. Cuevas, P. Nielaba, Phys. Rev. B 74, 235106 (2006).