Reversible conductance regulation of Si-based single-molecule junction by STM point-contact method

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Flexible and fine control of quantum transport through a single-molecule junction by such as changing of molecular conformation or modification of functional groups has been desired for developing molecular electronics. In this study, we have carried out dynamic analysis on *I-V* characteristics of a Si-based single-molecule junction using STM-point-contact method. A STM tip and a substrate surface made of a same n-type Si (001) wafer were used as electrodes. We used diethinylbenzene (DEB) molecule, whose triple bonds react covalently with the Si electrodes. A single-molecule junction was formed, by approaching a Si-STM tip toward an isolated DEB molecule adsorbed on a H-Si (001) substrate (Fig.1). After the molecular junction being formed, *I-V* curve measurements were performed. Figure 2 shows *I-V* curves obtained from a same DEB molecular junction with two different electrode distances. For a positive sample-bias voltage, the conductance increased with increasing electrode separation. For further analysis, we observed the change in current at positive (+1.8V) and negative (-1.8V) sample bias voltages (Fig. 3, upper) by changing the distance between the electrodes, *d*, in a triangular-wave form (Fig. 3, lower). For V_S = +1.8V, current showed an intriguing switching between a high and a low conductance state around *d*=-0.28nm, in addition to continuous change in conductance with electrode distance. These results demonstrate the high potential of single-molecule/semiconductor junction to realize novel functions desired for developing molecular devices. Details will be discussed at the conference.

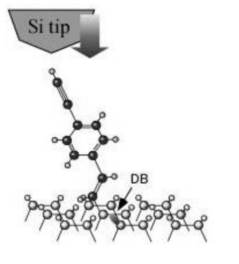

Fig.1 Formation of a junction.

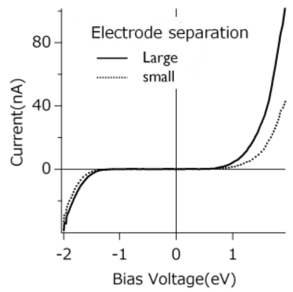

Fig.2 I-V curves obtained for two different electrode separations.

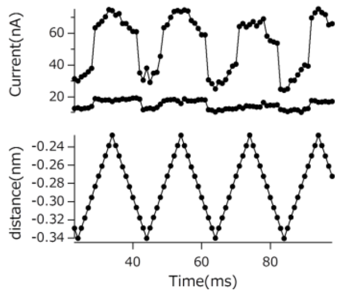

Fig.3 Change in current (upper) with electroede distance (lower).