Mechanical conductance regulation of Si based single molecular junction

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Control of carrier transport through a single molecule by changing molecular conformation and modifying functional groups has been an attractive challenge to realize molecular electronics. In this study, we have investigated I-V characteristics of Si based single molecular junction and the influence of molecular conformation by STM-point-contact method. STM tip and substrate surface made of a same n-type Si(001) wafer were used as electrodes. For a sample, we used diethinylbenzene (DEB) molecule whose triple bonds covalently react with Si electrodes. A single molecular junction was formed with the Si-STM tip being approached toward an isolated DEB molecule adsorbed on a H-Si(001) substrate (Fig.1). After formation of the junction, I-V curve measurements were performed with the STM tip being moved back and forward repeatedly. Figure 2 shows the current values at positive (+1.8V) and negative (-1.8V) sample bias voltages obtained from each I-V curve as a function of the tip-sample distance. A binary-conductance switching was reproducibly observed, showing hysteresis characteristics. The result clearly demonstrates a mechanical controllability of carrier transport in a single molecular junction.

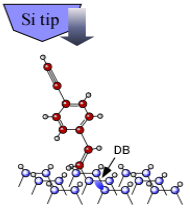

Fig.1 Formation of a single molecular junction

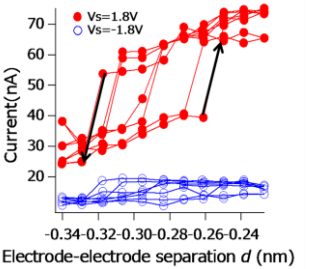

Fig.2 Currents at +1.8V (red) and -1.8V (blue) as a function of electrode distance.