

Formation of a Chain-like Water Single Molecule Junction with Pd Electrodes

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The interaction of water with solid surfaces plays an important role in a variety of field such as electrochemistry, corrosion, biochemistry, and so on. On the Pd surface, it is known that the water dissociation reaction occurs on Pd nano particles and oxygen coated Pd surface. The metal atomic junction is a one-dimensional nano material, and sometimes shows novel chemical reactivity. In this study, we, thus, investigated the interaction of the water molecule with Pd atomic junction.

The measurements were performed in the vacuum chamber at cryogenic temperatures. Pd atomic junction was fabricated by mechanically controllable break junction technique. The water molecules were introduced to the Pd atomic junction via a heated capillary.

Figure (a) shows examples of the conductance traces before and after introduction of water. After the introduction of water, additional steps appeared around $1 G_0$ ($G_0 = 2e^2/h$). Figure (b) shows the corresponding conductance histograms. The obvious peak was observed around $1 G_0$ after the introduction of water. The analysis of conductance traces revealed the formation of atomic chain after the introduction of water. The point contact spectroscopy measurements showed the vibrational mode of 70 meV, which could be assigned as the water-Pd stretching mode. The PCS confirmed the bridging of a water molecule between Pd electrodes. The symmetric configuration was found by the current-voltage characteristic. The symmetric I - V curves were observed for Pd atomic junction after introduction of water. Consequently, the fabrication of the stable and symmetric single water molecular junction which showed conductance of $1 G_0$ was clarified after the introduction of water into Pd atomic junction.

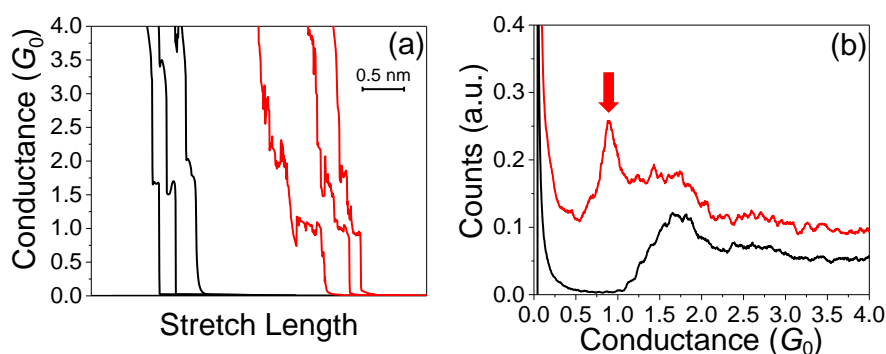


Figure (a) Conductance traces of clean Pd (black line) and Pd/water junction (red line). (b) The corresponding conductance histograms constructed from about 1000 conductance traces.

References:

[1] Risa Fukuzumi, Satoshi Kaneko, Shintaro Fjii, Tomoaki Nishino, Manabu Kiguchi, J. Phys. Chem. C in press. (2018)