Single-Molecule Electron Transport Properties of Sumanene Derivatives with Phosphine Sulfide Anchoring Groups

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Highly conductive single-molecule junctions have attracted significant attention due to their potential application to conductive wires in ultra-small electronic devices [1]. The direct binding of π-conjugated molecule to the metal electrodes is used to fabricate highly conductive single-molecule junctions [1,2]. However, the stability of single-molecule junctions obtained by the direct π-binding method is low because the direct π-metal bonding is not so strong compared to covalent bonds such as Au-S, Au-NH_2. In this study, we have investigated the single-molecule junction with the sumanene with three phosphine sulfide anchoring groups (PS sumanene) in order to obtain highly conductive and stable single-molecule junction. The single-molecule junctions were fabricated with the scanning tunneling microscopy-based break junction technique (STM-BJ) in ambient condition. Figure 1 shows the electric conductance histogram of the single-molecule junctions of PS sumanene as well as sumanene without the anchoring groups. The electric conductance of the sumanene junctions was around $0.1G_0$ ($G_0=2e^2/h$), which was one order higher than those of the conventional single-molecule junctions with anchoring groups [1]. The analysis of conductance traces during breaking process revealed that the formation probability of the single PS sumanene junction was about three times higher than that of the single sumanene junction without anchoring groups. In conclusion, we succeeded in fabricating highly conductive and stable single-molecule junction with PS sumanene.

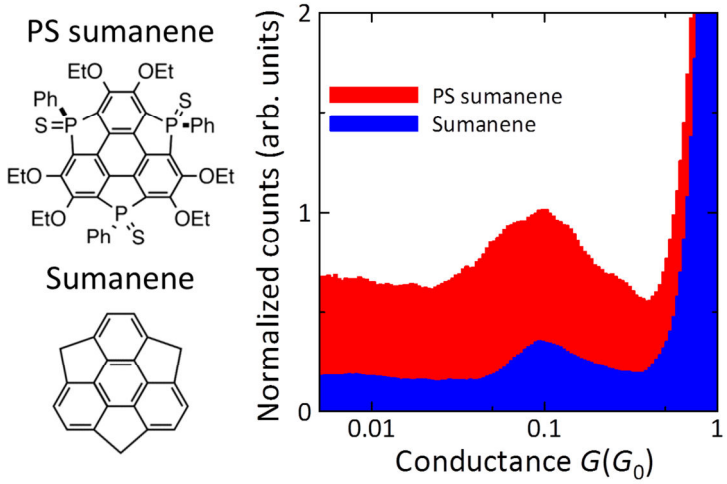

Figure 1: Conductance histograms of single PS sumanene junction and single sumanene junction

References:

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