Non-linear current-voltages character of Au quantum point contact — In this study, we simultaneously observed the configuration and the non-linear current-voltages character (I-V) of gold quantum point contacts (Au-QPC). UHV Transmission Electron Microscope (UHV-TEM) which combined with Scanning Tunneling Microscope (STM) enabled us to observe the configuration of QPC. TEM images were synchronized with the measured I-V. The bias voltage to Au-QPC swept from 0V to 0.3V at room temperature in UHV($\sim 1 \times 10^{-7}$ Pa). The Au-QPC with short length($< \sim 1$nm) showed the non-linear I-V which were fitted to a cubic function ($I=aV+cV^3$). The value of $c/a$ in our results ($\sim 20[1/V^2]$) was larger than that of previous reports ($0.3\sim 2[1/V^2]$). Simultaneous TEM images revealed a change of the width of Au-QPC. The width was found to increase from 1.1nm (0.02V) to 1.9nm (0.27V). On the other hand, the Au-QPC with long length (nanowire $>\sim 1$nm) showed the linear I-V, and the width was kept constant. We suggested that the changing of the width caused the non-linear I-V. The mechanism of increasing the width should be solved by further investigation.

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