Single-Electron Transistors made by Pt-based Narrow Line Width Nanogap Electrodes

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Many novel potential applications exploiting the advantage of single-electron transistors (SETs) have attracted the great attention owing to SET characteristics which can offer small device size down to sub-10 nm, low power consumption, high speed operation and single-electron sensitivity. Single electron transistor is a new type of switching device which controls single electron tunneling to amplify current. These SETs have been made with critical dimensions of just a few tens nanometers using metal electrodes. We have been using gold nanogap electrodes for the fabrication of SETs. However, SETs based on gold nanogap electrodes have the difficulty of fabrication because gold nanogap electrodes become unstable when the line width of nanogap electrodes is less than about 30 nm. Here we introduce platinum as a nanogap electrodes material which is expected to maintain the shape of the nanogap electrodes during the fabrication processes. We have fabricated the platinum nanogap electrodes with a narrow line width of under 14 nm and a small gap separation of 12 nm as shown in Fig. 1. According to our experimental results, these platinum nanogap electrodes have shown stable electrical characteristics. These platinum nanogap electrodes could be expected to improve a gate capacitance and elevate the operation temperature of SETs toward room temperature. Consequently, the Pt-based narrow line width nanogap electrodes have the advantage which can offer the reproducibility of fabrication processes and the stable single-electron transistor operation.

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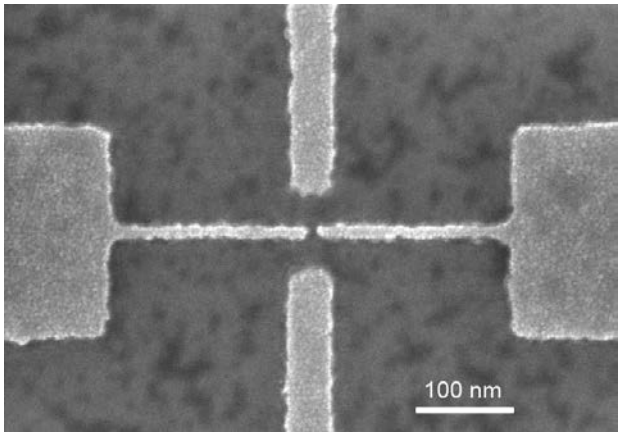

Figure 1. SET image of Pt-based Narrow Line Width Nanogap Electrodes