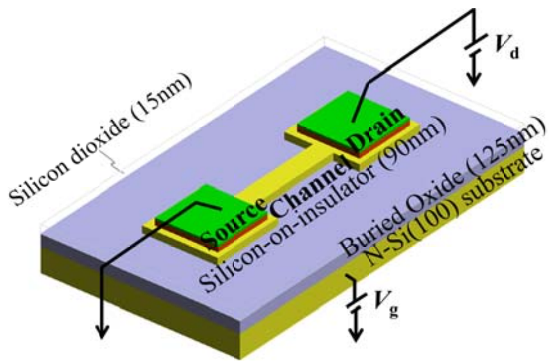
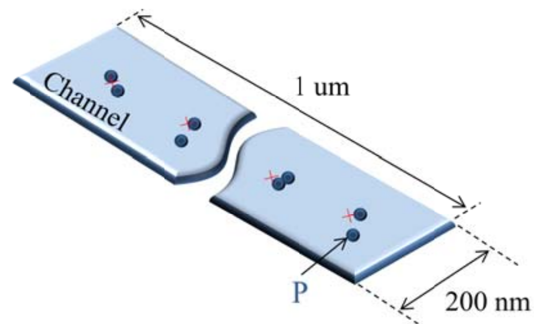
Activity Report (Short Term Mobility; 19th May ~ 1st June, 2013)

Kuninori Kumagai

**1. Purpose and Measurement Samples**

I have conducted noise measurement of semiconductor devices in Politecnico di Milano. Sample devices were fabricated in Waseda University in Japan. We used the silicon-on-insulator (SOI) substrate, and Channel size is 1 um long, 200 nm width, and 90 nm thick on the 125 nm thick buried oxide (BOX). Samples we measured this time in Politecnico di Milano were implanted phosphorus ions and put them in line (2 ions / dot) in the channel region at Waseda University. Single-ion Implantation Method [1] could realize these samples. The structure of our device is shown in figure1, and diagram of channel region with dopant line is shown in figure2.




substrate ine

We have already succeeded to observe the low temperature impurity band transport because of overlapping the neighboring wavefunctions in the region below the threshold voltage in the *V*g-*I*d curve characteristics at room temperature. So, we decided to measure the noise spectrum of electronic transport of our devices to understand and analyze the difference between the noise of impurity band transport and that of conduction band transport.

**2. *V*g-*I*d Curve and noise**

The *V*g-*I*d characteristics of P-doped sample of which distance between each dopant are 100 nm shows Hubbard band. We succeeded to observe impurity band transport again that is also observed in previous measurement.

From this result, we decided to measure the noise of electron transport mainly at some points indicated in figure3; the point of first rise of current, impurity band region and conduction band region.

We measured the noise spectrum by using correlation spectrum analyzer (CSA) that is produced in Politecnico di Milano. The results of noise spectrum measurements was done at drain voltage are all 10 mV.

There is difference between the noise at $V$g = 4 V with others. Then, we tried to measure the transition of noise spectrum from at $V$g = 2 V to $V$g = 4 V. We acquired 1/f noise at low frequency region (~ 1000 Hz) and ditinct noise at the other region.

The clarification of different noise between localized and delocalized regimes will be useful information to understand new mechanism of electron transport in physics, and contribute to accelerate the prospects for realizing devices with arrays of donors with novel properties and functionalities in the More than Moore perspective.


[1] Shinada, T. et al *Nature* **437**, 1128-1131 (2005).

[2] Voss, R. F. *J.Phys.* **C11**, L923 (1978)