Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Simulation of nanoscale four-probe resistance measurements under finite bias voltages ASAKO TERASAWA, KEIJI TOBIMATSU, TOMOFUMI TADA, TAKAHIRO YAMAMOTO, SATOSHI WATANABE, Dept. of Materials Engineering, The Univ. of Tokyo — To understand the interesting features in nanoscale four-probe measurements such as the negative value and the oscillation of four-probe resistance [1], we investigate the behavior of nanoscale four-probe resistance theoretically [2-3]. In the present work, we examine the effect of bias voltage on four-probe resistance in nanoscale four-probe systems. For a set bias voltage between current probes, we first estimate the voltage between voltage probes when no current flows between them from the four-probe and two-probe resistances at the zero-bias limit, assuming the linear response. Then we calculate the dependence of currents in the voltage probes on the bias voltage applied to the current probes with applying the voltage thus estimated between the voltage probes. The calculated currents in the voltage probes have nonzero but much smaller values compared with those in current probes, and show the non-linear dependence on the bias voltage. This result indicates assumption of linear response is not valid for the bias voltage of the order of a tenth V, and that currents and voltages should be determined self-consistently to estimate four-probe resistance. [1] B. Gao et al., Phys. Rev. Lett. 95, 196802 (2005). [2] A. Terasawa et al., Phys. Rev. B 79, 195436 (2009). [3] A. Terasawa et. al., New J. Phys. 12, 083017 (2010).

Asako Terasawa
Dept. of Materials Engineering, The Univ. of Tokyo

Date submitted: 19 Nov 2010 Electronic form version 1.4