Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Elementary process of electromigration investigated by novel spectroscopic approach to electrical break junctions AKINORI UMENO, KAZUHIKO HIRAKAWA, IIS, Univ. of Tokyo, INQIE TEAM, CREST-JST TEAM
— We have investigated electromigration process at gold nanojunctions by introducing a novel spectroscopic analysis. Gold nanojunctions were broken into nanogaps by passing large current, which was controlled by monitoring the evolution of junction conductance. We observed that, for the junctions as small as few tens of atoms, the junction conductance showed successive drops by one quantum (e2/h), corresponding to one-by-one removal of gold atoms, only when the junction voltage exceeded certain critical values. The histogram of the observed critical voltages showed a clear peak, Vp, and eVp was found to agree with the activation energy for surface diffusion of gold atoms. The result indicates that the elementary process of electromigration in such small junctions is the self-diffusion of metal atoms driven by microscopic kinetic energy transfer from a single conduction electron to a single metal atom. Technological implications of this new finding are also discussed in terms of reproducible formation of nanogap electrodes for single molecular junctions and also failure-tolerant interconnections for VLSIs.

Akinori Umeno
IIS, Univ. of Tokyo

Date submitted: 21 Nov 2008 Electronic form version 1.4