Use of Atomic Force Microscopy towards the Development of Nano Devices by Fabricating Oxide Patterns on Titanium thin Film

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For more than 4 decades, Complementary Metal Oxide Semiconductor (CMOS) technology has enabled a tenfold increase in computing performance every 5 years. Throughout that period, this trend has mainly been achieved by scaling down MOS devices. Emerging Research Devices (ERDs) are suggested to be required in the long term to help addressing this issue, not by replacing CMOS but rather by complementing it [1]. Among them Single Electron Transistors (SETs) are a kind of ERD that specifically features a low power consumption.

The principle of these devices is to use tunnel junction surrounding a metallic island in order to control transit of electrons through it and to use the effect of Coulomb blockade. The shape and interface control of the oxide tunnel junction are critical points of such devices. They require low permittivity and small surfaces of tunnel junction.

In this paper, we use AFM oxidation in tapping mode in order to draw the tunnel junctions and the pattern of nano devices (Figure 1). First, we evaluated the geometrical properties of oxide lines by measuring their height and protrusion width (FWMH). The study has been made using two parameters, the bias voltage applied on the tip to trigger oxidation and the oxidation duration. We still need to work on the influence of relative humidity and AFM scanning mode like non-contact and contact mode.

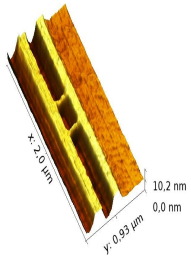

Figure 1: Topology of a SET

References

[1] The International Technology Roadmap for Semiconductors - 2007 Edition, Emerging Research Devices, Online:http://www.itrs.net/Links/2007ITRS/2007_Chapters/2007_ERD.