## Advanced Ion Microscopy and Ion Beam Nano-engineering Focus Topic
## Room Union Station AB - Session HI-ThP
## Advanced Ion Microscopy Poster Session

**HI-ThP-1 Fabrication of a Single Atom Ir/W(111) Tip by a Simple Sputtering Method*, Kwang-Il Kim,*** University of Science and Technology, Republic of Korea*; J Hwang,* Chungbuk National University, Republic of Korea*; T Ogawa,* Korea Research Institute of Standards and Science, Republic of Korea*; B Cho,* Korea Research Institute of Standards and Science (KRISS), Republic of Korea*; I Park,* Korea Research Institute of Standards and Science, Republic of Korea

Atomically defined tip, which is widely used as a gas field ion source (GFIS) for ion microscopes or a coherent electron source for electron microscopes, has been of importance in various fields, such as biology and material science, because its high brightness and angular current density can realize microscopes with high spatial resolution [1]. Single Atom Tips(SATs) can be typically fabricated by a build-up method or field-assisted reactive gas etching method with oxygen and nitrogen [2,3]. Tungsten (W) is a typical material for a tip because of the high melting point and mechanical stability. These characteristics of W are preferred especially to produce helium ion beams because it is easier to generate larger currents at higher electric fields. In recent years, the oxygen GFIS using SAT has attracted more attention in the field of Secondary Ion Mass Spectroscopy. However, W tips have limitation because they are corrosive in oxygen environments [4]. Thus, fabrication of SAT with a cover layer of inert FCC noble metals on tungsten tips with BCC structure has been proposed. The metals were deposited by the electroplating method [5]. Among FCC noble metals, Iridium has the possibility to achieve the highest brightness and stability among various BCC-FCC metal systems because it has the strongest bonding with tungsten and high resistibility against corrosion of oxygen [6]. In this study, we show that SAT can be fabricated by field evaporation effect in ultra-high vacuum system using a native tungsten tip that was not heated in the initial process to remove an oxide layer, which is generated with electrochemical etching. Additionally, the iridium was deposited by a conventional simple sputtering method. As a result of this study, we can fabricate an SAT of Ir(211) on W(111) using field ion microscopy by field evaporation and build-up process without pre-heating for removing initial oxidized layers. We also analyzed how the shape of the pyramid changes depending on the number of the build-up process and the electric field intensity applied in the faceting process. Since this method uses a conventional sputtering coater, the complexity of the equipment configuration could be eliminated compared to that in previous studies.

[1] N.Economou et al., Scanning 34(2): 83-89, 2012

[2] M. Rezeq et al., The Journal of chemical physics, 124(20), 204716, 2006

[3] VT Binh et al., Surface Science, 202(1-2), L539-L549, 1988

[4] Wood, John A., et al. Applied Surface Science 367 (2016): 277-280.

[5] Kuo, Hong-Shi, et al. nano letters 4.12 (2004): 2379-2382.

[6] Oshima, Chuhei, et al. e-Journal of Surface Science and Nanotechnology 16 (2018): 294-297.

**Preference: Poster**

**HI-ThP-2 Morphology Modification of Si Nanopillars under Ion Irradiation at Elevated Temperatures*, Xiaomo Xu,*** *K Heinig,* Helmholtz Zentrum Dresden-Rossendorf, Germany*; W Möller,* Helmholtz-Zentrum Dresden-Rossendorf, Germany*; H Engelmann, N Klingner,* Helmholtz Zentrum Dresden-Rossendorf, Germany*; A Gharbi, R Tiron,* CEA-LETI, France*; J von Borany,* Helmholtz Zentrum Dresden-Rossendorf, Germany*; G Hlawacek,* Helmholtz-Zentrum Dresden Rossendorf, Germany

Ion beam irradiation of vertical nanopillar structures can be utilized to fabricate a vertical gate-all-around (GAA) single electron transistor (SET) device in a CMOS-compatible way. After irradiation of Si nanopillars (with a diameter of 35 nm and a height of 70 nm) by either 50 keV broad beam $Si^+$ or 25 keV focused $Ne^+$ beam from a helium ion microscope (HIM) at room temperature and a fluence of 2e16 ions/$cm^2$, strong deformation of the nanopillars has been observed which hinders further device integration. This is attributed to ion beam induced amorphization of Si allowing plastic flow due to the ion hammering effect, which, in connection with surface capillary forces, dictates the final shape. However, plastic deformation can be suppressed under irradiation at elevated temperatures (investigated up to 672 K). Then, as confirmed by bright-field transmission electron microscopy, the substrate and the nanopillars remain crystalline, and are continuously thinned radially with increasing fluence down to a diameter of 10 nm. This is attributed to enhanced forward sputtering through the sidewalls of the pillar, and found in reasonable quantitative agreement with the predictions from 3D ballistic computer simulation using the TRI3DYN program.

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