Advanced Ion Microscopy Focus Topic
Room Hall D - Session HI-ThP

Aspects of Advanced Ion Microscopy Poster Session

HI-ThP1 Gas Field Ion Sources from Single-Atom Tips*, **W.T. Chang, C.Y. Lin, W.C. Lai, Y.F. Yu,* Institute of Physics, Academia Sinica, Taipei, Taiwan, Taiwan, Republic of China*; T.Y. Fu,* National Taiwan Normal University, Taipei, Taiwan, Taiwan, Republic of China*; T.T. Tsong, I.S. Hwang,* Institute of Physics, Academia Sinica, Taipei, Taiwan, Taiwan, Republic of China

Focused ion beams (FIBs) have been widely used in a large number of applications, such as high-resolution scanning ion microscopy, lithography, nanofabrication, secondary ion mass spectroscopy (SIMS), serial sectioning tomography, etc. Current FIB systems have relied on the high brightness, moderate energy spread, ease-of-use, and robustness of the gallium liquid metal ion source (LMIS). One of the main drawbacks of LMIS-FIB system s is the inevitable contamination of liquid metal i n materials . To extend the applications of FIB technology, it is essential to develop high-brightness ion sources of various species because different ion beams serve different purposes. It has been well recognized that the brightest ion sources are gas field ion sources (GFISs). The virtual source size (~1 nm or smaller) and the energy spread (<1 eV) of GFISs are at least one order of magnitude smaller than those of LMISs. This implies GFIS-FIB systems can achieve a much better resolution than the current Ga-FIB systems. Another important advantage of GFIS-FIB systems is that the same emitter is capable of producing different ion beams simply by changing the gas species.

Since 2006, Zeiss Orion helium ion microscope (HIM) [1] successfully demonstrated a spatial resolution better than 0.5 nm. The HIM uses a pure tungsten trimer tip as the emitter and two ion species, He^+ and Ne^+, can be stably emitted. Here we present another type of GFIS emitters, n oble-metal covered tungsten single-atom tips (SATs), which can reliably produce a wider variety of ion species. These SATs are thermally stable and chemically inert, and thus can be generated and regenerated through annealing [2]. Helium, neon, argon, hydrogen, oxygen, nitrogen, and recently xenon ions have been emitted from this type of SATs. Light ions have the lowest sputtering rates and are beneficial for scanning ion microscopy. Heavy ions can provide a high sputtering rate, suitable for ion milling. Due to the high secondary ion yields, oxygen and xenon ion beams can be applied to SIMS. These SAT-GFISs have a half opening angle ~0.5° and a brightness several orders of magnitude higher than that of Ga-LIMS. The ion current of these SAT-GFISs are very stable (instability <5%). Since these SATs can be regenerated for more than 50 times, therefore their lifetimes are sufficiently long for most practical applications.

References

Scanning 28, 63 (2006); Photonics Spectra 41, 68 (2007); J.Vac. Sci. & Technol.B 24, 2871 (2006).

Phys Rev B 64 113401(2001); Nano Letters 4 2379 (2004); Jap. J. Appl. Phys. 45 8972 (2006); Appl. Phys. Lett. 92 063106 (2008).

Author Index

Bold page numbers indicate presenter

— C —
Chang, W.T.: HI-ThP1, **1**
— F —
Fu, T.Y.: HI-ThP1, 1
— H —
Hwang, I.S.: HI-ThP1, 1
— L —
Lai, W.C.: HI-ThP1, 1
Lin, C.Y.: HI-ThP1, 1
— T —
Tsong, T.T.: HI-ThP1, 1
— Y —
Yu, Y.F.: HI-ThP1, 1