NanoSIMS in Orion NanoFab

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The Orion NanoFab featuring a high brightness gas-field ion source (GFIS) has been demonstrated as a tool for high resolution imaging and sub-10 nm nanofabrication with He and Ne ions [1]. The appreciable sputter yield from the primary Ne ions results in secondary ions generated from the sample surface like in Secondary Ion Mass Spectroscopy (SIMS). By integrating a custom designed mass spectrometer to this platform, analytical and elemental characterization capabilities have been enabled to add to the existing capabilities of the tool [2-4]. The ability to perform high sensitivity surface analysis and depth profiling with large dynamic range detecting all elements and differentiating isotopes with SIMS complements the surface sensitive imaging observed with this tool.

Unlike other sources used in commercially available SIMS systems, the small probe size of the He or Ne GFIS pushes the resolution to around 10 nm which is fundamentally limited by the ion – sample interaction and lateral collision cascade [4-5]. We have demonstrated that our instrument is capable of producing elemental SIMS maps with lateral resolution down to 12 nm [4-6]. Furthermore, the instruments opens up an in-situ correlative imaging technique combining high resolution SE images and SIMS elemental maps. Application of this technique to nanoparticles, microelectronics, battery materials, solar cells and various other fields will be highlighted in this work to elucidate the powerful correlative microscopy enabled by this integrated HIM-SIMS platform.

References:

[1] G. Hlawacek, A. Gölzhäuser, Helium Ion Microscopy, Springer, 2017

[2] T. Wirtz, N. Vanhove, L. Pillatsch, D. Dowsett, S. Sijbrandij, J. Notte, Appl. Phys. Lett. 101 (4) (2012) 041601-1-041601-5

[3] L. Pillatsch, N. Vanhove, D. Dowsett, S. Sijbrandij, J. Notte, T. Wirtz, Appl. Surf. Sci. 282 (2013) 908-913

[4] T. Wirtz, P. Philipp, J.-N. Audinot, D. Dowsett, S. Eswara, Nanotechnology 26 (2015) 434001

[5] P. Gratia, G. Grancini, J.-N. Audinot, X. Jeanbourquin, E. Mosconi, I. Zimmermann, D. Dowsett, Y. Lee, M. Grätzel, F. De Angelis, K.Sivula, T. Wirtz, M. K. Nazeeruddin, J. Am. Chem. Soc. 138 (49) (2016) 15821–15824

[6] D. Dowsett, T. Wirtz, Anal. Chem., 89 (17), 2017, pp 8957–8965