Correlated Laser Ionization/TOF-SIMS Imaging Mass Spectrometry with Continuous C60 Ion Beam

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Secondary ion mass spectrometry, as a powerful surface analysis tool, is widely used in semiconductor and geoscience applications. Especially, with the advancement of cluster ion source technology, TOF-SIMS has received widespread attention in biochemical imaging, such as spatially resolved metabolomics research. However, despite the high sensitivity and excellent spatial resolution of SIMS, relying solely on the m/z information of the secondary ions is difficult to describe the sample surface information, including chemical valence state, pathological features, and surface morphology. Correlated technologies such as Raman/infrared spectroscopy, optical microscopy, electron microscopy SEM, and MALDI can complement the SIMS technology well. In recent years, correlated imaging technologies and instruments have attracted strong interested.

In this work, we have constructed a correlated laser ionization/TOF-SIMS imaging mass spectrometry with continuous C_{60} cluster primary source. The instrument including the C_{60} ion beam, Schwarzschild optical microscope, ion extraction and transfer system and W-TOF mass analyzer. Schwarzschild microscope features a large numerical aperture (NA=0.47), a 50 mm working distance, and excellent coordination with the ion extraction system. A spatial resolution of 0.7 μm has achieved, with an imaging field of view of 300 μm * 400 μm, primarily utilized for sample navigation and micro-area positioning. The ion transfer system consists of three-stage quadrupoles, enabling ion cooling, mass filtering, and ion enrichment. Currently, the mass resolution of TOF-SIMS has reached 15,000. The microscope imaging and mass imaging of the 200-mesh molybdenum mesh and Indium foil surface are shown in Figure 1(b) and (c), respectively.

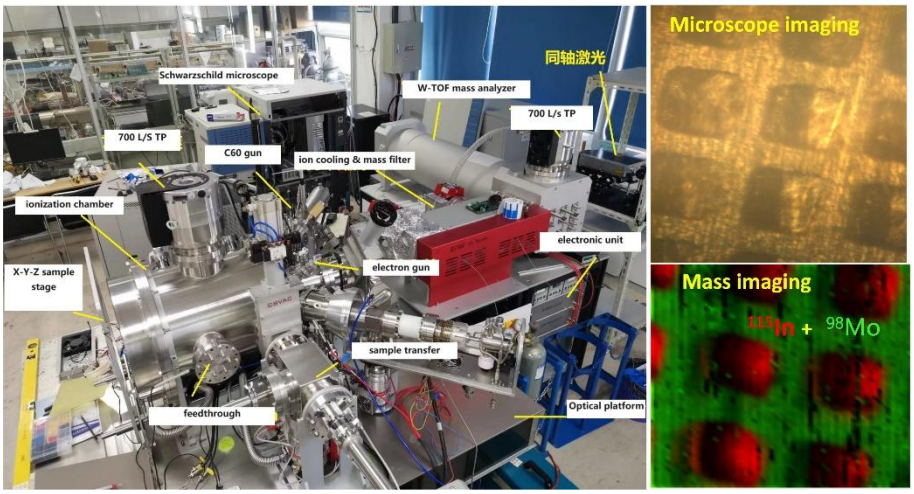

Figure 1. (a) Instrument overview of the correlated microscope/SIMS imaging mass spectrometry. (b)Microscope imaging of the 200-mesh molybdenum mesh and Indium foil surface. (c) Mass imaging of the 200-mesh molybdenum mesh(green) and Indium foil surface(red).