Recent Applications of GCIB Depth Profiling with XPS and TOF-SIMS

Takuya Miyayama[1], Noriaki Sanada[1] and John S. Hammond[2]

1. Ulvac-PHI, 370 Enzo, Chigasaki, Kanagawa, 253-0084, Japan

2. Physical Electronics, 18725 Lake Drive East, Chanhassen, MN, USA, 55317

The development of new electronic devices incorporating organic materials, such as Organic Light Emitting Diodes (OLED's) and Organic Photovoltaics (OPV's) is rapidly increasing. To control quality, performance and lifetimes of these devices, it is necessary to characterize the layer structures and the dopant distributions in the thin organic materials. Conventional surface analysis techniques such as XPS and TOF-SIMS, combined with mono-atomic ion beam sputtering, have been widely used for chemical depth profiling of inorganic thin films. However, this approach has not been successful for the depth profiling of organic materials due to the loss of chemical information during the sputtering process. Recent cluster ion beam developments utilizing C_{60} and Coronene ions have also had limited success for the XPS and TOF-SIMS depth profiling of OLED and OPV structures due to similar modification of chemical and molecular information as a function of sputter depth.

The chemical depth profiling of organic layers with thicknesses greater than one micron has also been problematic utilizing XPS and TOF-SIMS with C_{60} cluster sources. The implementation of new cluster ion sources that could extend chemical depth profiling of organics to more than several microns should also expand the applications of the XPS and TOF-SIMS techniques.

Recent studies have shown the successful use of a GCIB (gas cluster ion beam) source on XPS (X-ray photoelectron spectroscopy) instruments to quantify the chemical depth profile of polyimide films without sputter induced chemical degradation[1, 2]. Based on these earlier experiments, additional GCIB depth profiling applications of organic and biomaterials with XPS and TOF-SIMS will be discussed. Examples will be presented for the characterization of ultra-thin organic electronic layers in OLED's and OPV's. The successful organic depth profiling to depths of several tens of microns will also be discussed.

1. Takuya Miyayama, Noriaki Sanada, Mineharu Suzuki, John S. Hammond, S. –Q. D. Si and Atsushi Takahara, *J. Vac. Sci. Technol. A.* 2010, A 28(2), L1

2. Takuya Miyayama, Noriaki Sanada, Scott R. Bryan, John S. Hammond and Mineharu Suzuki, *Surf. Interface Anal.* 2010, *42,* 1453–1457.