C_{60} and Gas Cluster Ion Beam Depth Profiling of Organic Materials

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The past 6 years has witnessed a paradigm shift in the use of cluster ion beams for the sputter depth profiling of organic materials with the surface analysis techniques of XPS and TOF-SIMS. Today the use of low energy mono-atomic ions such as Ar^+ for depth profiling has been replaced with cluster ions such as SF_5^+, coronene and C_{60}^+ for many fluorinated polymers, polyesters and even some biological materials. With the increase in the number of different organic materials studied with these cluster ion sources, it is becoming apparent that some polymer systems such as polyolefins, highly cross-linked polymers and polyimides can not be profiled with these ion sources and still maintain the expected elemental compositions and molecular ion fragment spectra initially observed on the surface of these materials during the sputter depth profiling experiments.

An alternative cluster source will be discussed for these very challenging materials. A gas cluster ion beam (GCIB) with an average of 2,500 Ar atoms per single charged ion has shown dramatic results that compliment the previous experiments with C_{60}^+ sputter ion sources. Sputter depth profiling results using both XPS and TOF-SIMS with C_{60}^+ and CGIB sources will be presented for thick films of polycarbonate and polyimide polymers. The XPS results will be used to quantify the elemental compositions during the depth profiles of these materials as a function of GCIB operating conditions. TOF-SIMS data with a GCIB source will illustrate consistent molecular fingerprint spectra during the depth profiling. Additionally, GCIB sputtering to efficiently remove the molecular damage caused by analytical, i.e. liquid metal ion gun (LMIG), primary ions will be discussed.