

CHEMICAL ANALYSIS AND CHARACTERIZATION OF NANOLAYERS ON CONDUCTING AND INSULATING SUBSTRATES BY PULSED RADIOFREQUENCY GLOW DISCHARGE TIME OF FLIGHT MASS SPECTROMETRY

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Direct surface and depth profiling chemical analysis of multilayer materials demands a “multi-dimensional” knowledge, including simultaneous elemental and molecular information to characterize the new materials. Pulsed radiofrequency glow discharges (pulsed rf-GDs) with detection by time of flight mass spectrometry (TOFMS) allow to obtain direct chemical information from a great variety of materials in a fast and easy way. A glow discharge is a low pressure plasma produced in an inert atmosphere due to a voltage applied between two electrodes, being the cathode the sample to analyze. Ions and fast atoms impinge on the cathode producing its erosion. The atoms and clusters sputtered from the surface of the sample are diffused into the plasma where they are excited and ionized. If radiofrequency power (instead of direct current) is applied to the electrodes, the discharge can be ignited even when the cathode is a non conductor. Therefore, the application field of rf-GDs covers a wide variety of materials (metals, oxides, glasses, polymers...). On the other hand, the temporal distribution of the applied power in pulsed rf-GDs produces three main regimes in the discharge (prepeak, plateau and afterpeak) with different mechanisms of ionization. As a result it is obtained a real possibility of measuring elemental and molecular ions at the different regimes when coupling the GD ion source to a fast mass spectrometer such as the time-of-flight mass spectrometer (TOFMS) [1].

Therefore, development of new instrumentation based on pulsed (rf)-GD-TOFMS is being investigated in the frame of an European Project [2]. In this work, it is evaluated the capability of a pulsed rf-GD-TOFMS prototype to provide depth profiling analysis of thin and ultra-thin layers deposited on different types of substrates. This study covers different types of layers and substrates: a Cr delta layer of 2 nm in an alumina layer on Al, thin B layer on Si or several ultra-thin layers deposited on glass substrates. Also, different polymers like Polymethyl methacrilate (PMMA), polystyrene PS, polyethylene terephthalate-co-isophthalate (PET) deposited on silicon wafers are studied using the pulsed rf-GD-TOFMS and the molecular information that can be extracted from the qualitative profiles is investigated.

References:

- [1] M. Hohl, A. Kanzari, J. Michler, T. Nelis, K. Fuhrer and M. Gonin, *Surf. And Interface Anal.*, **38** (2006) 292.
- [2] “*New elemental and molecular depth profiling analysis of advanced materials by modulated radio frequency glow discharge time of flight mass spectrometry*” Targeted Research Projects (STREP) 032202 EMDPA