Abstract #1030, 223rd ECS Meeting, © 2013 The Electrochemical Society

Comparative studies of depth profiling by XPS, SIMS, GD-OES and SEM techniques performed on the electrodeposited silicon based films

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Electrochemically grown Si based films are a very attractive prospect for the device fabrication in a broad range of applications. Their properties, physical and chemical, strongly depend on the thickness. There are several, indirect and direct methods for their thickness determination. Among them there is an electrochemical (from electrodeposition charge) and ellipsometric method, Quartz Crystal Microbalance (QCM), profilometry, a magnetic induction method, SEM and AFM/STM technique. The depth profiling by X-Ray Photoelectron Spectroscopy (XPS), Secondary Ion Mass Spectroscopy (SIMS), and Glow Discharge Optical Emission Spectroscopy (GD-OES) is the other group of methods often applied.

The advantage of application of XPS, SIMS and GD-OES is the possibility of the thickness determination with simultaneous determination of chemical consistence of the produced films. However the results obtained by these three techniques differ from each other quite often.

In this presentation, the method of a-Si films synthesis will be presented followed by discussion on the use of the three spectroscopic techniques mentioned above for characterization of such films and related to the deposits' thickness registered by SEM. The dependence of chemical composition and films thickness on electrodeposition potential will be presented. The difference in thickness and chemical composition as determined by these techniques will be discussed and related to the physical mechanism underlying each technique (ways of excitation and ionization, type of monitored and detected particles).

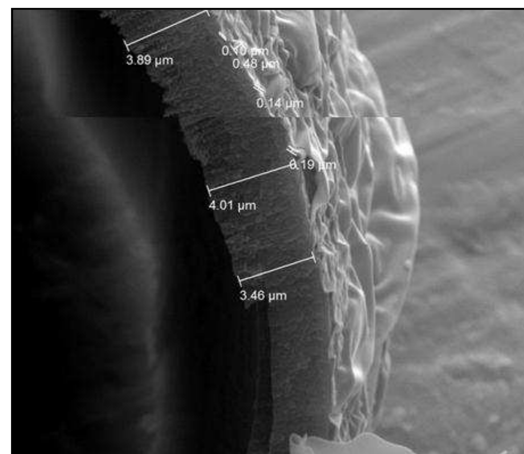

Fig.1. SEM image of the deposit obtained on Cu from 0.5 M solution of $SiHCl_3$ in 0.1 TBAB/PC at -2.25 V vs. Ag-wire, deposition time: 1h

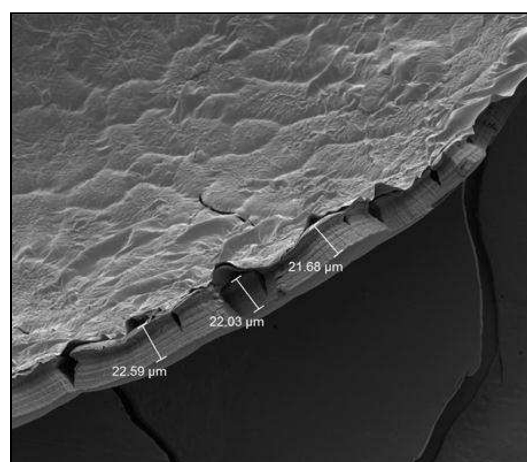

Fig.2. SEM image of the deposit obtained on Cu from 0.5 M solution of $SiHCl_3$ in 0.1 TBAB/PC at -2.75 V vs. Ag-wire, deposition time: 1h

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