SIMS Analysis of Beryllium Films Prepared by TVA Method

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An important goal of the ILW Project and its contribution to ITER is to assess the Be erosion from the main chamber plasma-facing components. For that purpose marker tiles made of bulk Be, 2-3 μm Nickel and 7-8 μm Be films were produced. This would allow erosion measurement up to this depth, whereas for assessing erosion greater than that the tiles will have precise notches 10 and 20 μm deep. The Be marker layer must be adherent to the substrate and compact to resemble bulk Be in order to make the measurements conclusive. Thermionic Vacuum Arc (TVA) method based on the electron-induced evaporation [1] has been selected for this purpose. The behaviour of the deposited Be layer at different temperatures is crucial for the marker tile fuel retention and release. For this purpose, some graphite, tungsten and Si substrates were coated with Be, BeW, Be+CW films and annealed at 100, 300 and 400ºC temperature. Secondary ion mass spectrometry (VG IX70S double focusing magnetic sector SIMS) was applied for the depth profiling of the Be, O, H and C atoms, as well as BeO molecule. Were used O_2^+ (5keV) primary ions, ion current 250 nA, sputtered area 300 x 220 μm^2. In order to infer Oxygen content and formation of BeO molecule were used Xe^+ (5keV) primary ions, ion current 250 nA. The sputtering rates were: 0.56nm/s (Be/W) and 0.73nm/s (Be+CW).

On some samples was found low concentration of carbon in the Be/Si interface. Be has a peak in the W/Be interface and this could be due to matrix effects; secondary ion yield may change at the interface which changes the signal intensity even though the Be amount may be constant. Another possibility is that W and Be react at the interface.

The SIMS depth profiles measured with a Xe^+ beam look different. Both W/Be and Be/Si interfaces were sharp when compared with previous analyses with O_2 beam. Were found some C and O impurities at the W/Be interface and inferred a clear difference in the SIMS depth profiles. In the case of Be films coated on Si (annealing temperature 100 ºC) the interfaces were sharp, but they were broadened for samples annealed at 300ºC and 400ºC , respectively. Oxygen amount increases as a function of temperature, leading at BeO formation, as shown in Fig. 1.

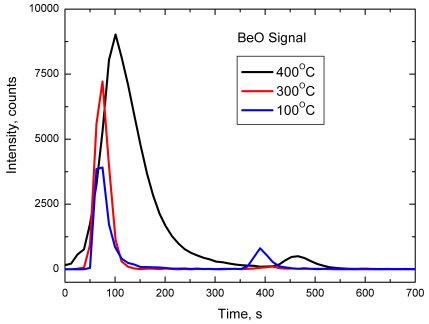

Figure 1. The BeO SIMS depth profile of the 200 nm Be film with 50 nm W top layer.

[1]. C. P. Lungu, I. Mustata, V. Zaroschi, A. M. Lungu, A. Anghel, P. Chiru, M. Rubel, P. Coad G. F. Matthews and JET-EFDA contributors, Beryllium Coatings on Metals: Development of Process and Characterizations of Layers, Phys. Scr. T128 (March 2007) 157–161.