XPS Depth Profiling of Tungsten-Carbide Nano Coating Layers

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The characterization of the nano layers, is mainly carried out by various transmission electron microscopic techniques, which are rather time consuming and in many cases the determination of the chemical composition of the layers is not straightforward. To overcome these problems, surface sensitive analytical methods (XPS, AES) combined with sputter depth profiling can be applied. However, these techniques might introduce serious alterations to the sample. But even in light of this, the combination AES and/or XPS depth profiling remains a powerful tool to further the thorough understanding of nano-systems. We have demonstrated that tungsten carbide nano-layers (in the range of 10-30 nm), exhibiting excellent corrosion and wear resistance features [1,2] could be produced at room temperature by ion beam mixing of C/W/C… multilayer systems. The chemistry of samples was studied by AES depth profiling, which provided an accurate description of the layer formation process [3] but could not directly identify the type of tungsten carbide produced. To cope with this problem, XPS depth profiling was applied for the same samples; these results will be summarized in this talk. First we will describe the evaluation method which accounts for the relatively high inelastic mean free path of the XPS electrons, and then we will show that the tungsten carbide produced by ion beam mixing is W2C instead of WC which was proposed earlier, based on the results of the AES studies.

[1] Racz, A. S. et al. Tungsten Carbide Nanolayer Formation by Ion Beam Mixing with Argon and Xenon Ions for Applications as Protective Coatings, ACS Appl. Nano Mat., 6, 5, 3816 (2023)
[2] Racz, A. S. et al. Corrosion Resistance of Tungsten Carbide-Rich Coating Layers Produced by Noble Gas Ion Mixing. Appl. Surf. Sci., 605, 154662 (2022)
[3] Racz, A.S. et al. Evaluation of AES Depth Profiles with Serious Artefacts in C/W Multilayers, Appl. Surf. Sci., 582, 152385 (2022)