LABORATORY MADE CODEPOSITED LAYERS FOR FUEL REMOVAL STUDIES

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Laboratory made co-deposited layers are of high importance for the validation of fuel removal techniques (by laser, discharge, etc), and of monitoring techniques. In addition, the adoption of a common model for the codeposited layers to be used with different cleaning techniques favors the comparison of results, as example the cleaning efficiency rates.

In this contribution we propose variants of models for the codeposited layers and report on the layers deposition process and their properties. Preliminary results on cleaning with a plasma torch are included.

As a primary model amorphous hydrogenated carbon layers were deposited by Plasma Assisted Chemical Vapor Deposition (PACVD) in vacuum, using acetylene as precursor. The main advantage of the PACVD is the incorporation of hydrogen, which can be regarded as substitute for tritium in the codeposited layer. Incorporation of hydrogen is difficult with other deposition techniques (magnetron sputtering or arc evaporation methods). Such layers are easy obtained on various substrates (graphite, CFC, tungsten) at deposition rates high enough for production of thick layers.

As a second laboratory model we have searched for carbon/metals/hydrogen mixtures. We have established as a promising approach for obtaining such layers a combination of PACVD with magnetron sputtering. A deposition system based on two plasma sources has been set-up in which the metallic component and the carbon and hydrogen are sequentially supplied by magnetron sputtering and plasma decomposition of a gaseous precursor (specifically acetylene), respectively. In the two plasma sources approach the substrate moves in a few seconds from a plasma source to another, the composition being controlled by the time of substrate exposure to one or another plasma source. Samples consisting of layers of mixed Al/a-C:H materials, (with Al as substitute of Be) deposited on polished graphite substrates and tungsten were realized. The main advantage of the sequential deposition method is the possibility of controlling the film composition and morphology by adequate adjustment of T_{Al} and T_C deposition times.

The conditions in which mixed layers can be obtained were identified, consisting in cycle times and plasma generation (RF powers and gas flow rates) parameters. The composition of the layers was examined by EDX (Energy Dispersive X-ray analysis) while the morphology using SEM (Scanning Electron Microscopy). Layers of the type a-C:H/Al with low Al content proven to be stable (limited oxidation, remain adherent on substrates), while at higher Al content a fast oxidation occurs leading to delamination. This behavior can be caused by the fast oxidation of the tiny Aluminum particles (large specific surface) included in the hydrogenated carbon matrix films, oxidation which might have an explosive potential. Thus, the research raised an issue on safety. In case that Be/C composites has a behaviour similar to Al/C, a potential for explosion may appear when the surface covered with codeposited Be/C layer come into contact with the atmosphere. In addition, the delaminated layers (debris) are a source of dust in the machine which is also an important issue.