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Association of different sp3 activation effects competing against sp2 degradation in optimization of hard carbon coatings

Stephane NEUVILLE[1]

[1]TCE, CUISY, France

stephane.neuville709@orange.fr

The better understanding of the sp3 growth mechanisms appears to be an essential aspect for the mastering and optimization of up scaled more performing ta-C hard carbon coatings. Published growth models only based on various ion impact effects did not provide satisfying explanations to the growth of ta-C and diamond films. More recent ones have suggested the role of electronic excitation effects in the atomic rearrangement producing metastable solid state carbon materials beside the usual thermal thermodynamic considerations. It could be shown here in agreement with all different types of identified hard carbon growth processes, the role of the release of various types of recombination energy, among them chemical (CRER), adsorption (AER) and neutralization (NER) recombination energy release beside other more conventional X ray, UV photons, electron and ion impact activation processes before this recombination and excitation energies will be transformed into heat. Notwithstanding the point that these sp3 activation effects will be in competition with various thermal and amorphysing graphitic degradation effects and will contribute at different levels to the coating stress. This is especially well shown in diamond processes where no ions or no amorphysing ion impact energies are present, and where the main sp3 activation mechanisms are either the recombination of H atoms to H2 molecules, the adsorbtion and condensation events of high chemisorbtion energies and the neutralization of a high flux of impinging ions at the growing film surface. It will be shown that those atomic rearrangement activation effects will also be in agreement with some already observed catalytic sp3 enhancement effects, as long as not hidden by other overwhelming graphitization mechanisms. The usual ion impact sp3 activation model can then be assimilated to a particular case of valence band electron excitation. With the right choice and association of process device combination, taking into account above described effects it will be expected some possible optimized processes with which better performing harder and less stressed ta-C will be achievable.

Keywords
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