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Sp³ enhancing effects and stress optimisation in hard carbon materials

By
Stéphane Neuville

Tetrahedral Carbon Engineering, 1 rue du Gal de Gaulle, F-77165 CUISY (France), Tel. +33(0)1 64 36 14 07 Mob. +33(0)6 77 66 96 05, Email stephane.neuville709@orange.fr.

Abstract:

Up to now, only a limited number of depositing means have been used to produce ta-C coatings whereas many others are expected to be developed with the proper association and optimization of all identified effects in favour of sp³ sites. Yet, most actually used corresponding depositing devices suffer, in general, from a number of limiting drawbacks, concerning depositing rates, substrate shape and size, adhesion and stress which have to be reduced for many expected unique applications of the ta-C and related material coatings.

In order to look about the possibility to optimize the depositing of better performing ta-C coatings of lower intrinsic stress, we proceed with some qualitative theoretical investigation on the coating growth mechanisms over the depth and the substrate surface of all sp³ site activation effects. Some of those will produce stress by subplantation effects and some others will produce a local temperature increase which is able to induce atomic displacements and migration known to relax the stress, but unfortunately which are also in favour of sp² sites. This qualitative analysis suggests distinguishing above mentioned effects in order to enhance with appropriate coating device design and some optimized process parameters all of them which are promoting sp³ sites, and which are reducing at same time the intrinsic stress. Therefore, in association to the optimization of the coating/substrate interface, these newly developed considerations are suggested to be used for the optimisation of coater design, and the process parameters, in the search of the best compromises between stress, and combination of actual outstanding material properties specific to ta-C and related coatings.

