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Synthesis and characterization of some C-Ti based multilayer and composite nanostructures

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Using TVA technology, multilayer and composite C-Ti layers were deposited on silicon substrates. The C-Ti multilayers were constructed from the silicon substrate as follows: 100nm of carbon, followed by alternant 17nm Ti and 40 nm C three times, covered by one last 17 nm Ti layer, resulting a seven multilayer structure. For the composite layer, after the pre 100nm carbon one, we varied quasi continuously the Ti:C atomic ratio, from 1:9 and reaching 9:1 at the top of the 119 nm. For both composite and multilayer structures, several batches were obtained for comparison. We varied the substrate temperatures during the deposition (R. T.,100, 200, 300 and 400oC) and one deposition batch was obtained at 300oC with a -700V polarisation voltage on the substrates, in order to increase the ions energy reaching the layer, during the coating process.

Characterization of structural properties of films was achieved by Electron Microscopy technique (TEM) and GIXRD techniques. The measurements show that increase of the substrate temperature reveal changes in TixCy lattice parameters. Thus, according to GIXRD analysis it was found out that the Ti:C atomic ratio changes with increase of synthesis temperature. Also, in the case of composite films an increase of amount and sizes of TiC nanocrystals with the increase of energy of Ti ions determined by increase of polarisation voltage was observed. The tribological measurements were performed using a ball-on-disk system with normal forces of 0.5, 1, 2, 3N respectively. Was found that the coefficient of friction depends on the synthesis temperature and on the polarisation voltage. It is also noted that the friction coefficient depends on the pure C content, Ti content and amount of TiC nanocrystallites. These results are due to atomic diffusion at Ti/C interfaces and also are associated with amount of TiC nanocrystallites. Using Bruker Hysitron TI980 Triboindenter System, global hardness of the coating, in depth hardness and SPM imaging analysis were performed. By Nanoscratch Analysis, global and depth Young modulus was measured. To characterize the electrical conductive properties, the electrical surface resistance versus temperature have been measured, and then the electrical conductivity is calculated. Using the Wiedemann-Frantz law was obtained the thermal conductivity.

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