Characterization and selection of carbon steels for vanadium carbide thermodiffusion process

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The development of a high-performance cutting tool by combining the cutting capacity of synthetic diamonds with the mechanical properties of steels is much desired to improve finishing in the machining aerospace alloys. In order to improve the adhesion and the quality of CVD diamond coatings on steels, an intermediate layer is required to act as a residual stress reducer after cooling and to promote an efficient diffusional barrier to the migration of the intermediate metals from the substrate. Carbonaceous coatings such as chromium carbide and silicon carbide have been used to improve the mechanical properties, protection against corrosion and strength of steels; however, they have proved to be an excellent intermediary material for the deposition of diamonds on cutting tool steels substrate. Therefore, vanadium carbide was selected to be used as an intermediate material through deposition by thermodiffusion reactive process (TD-VC). The thermodiffusion vanadium carbide (TDVC) process consists in a powders mixing $10H_20.Na_2B_4O_7$ (borax), V_2O_5 and B_4C placed in a crucible and heated in a furnace at 1050°C where the deposition process occurs. This work aims to select the best steel substrates for VC layer formation and HFCVD diamond deposition. The vanadium carbide deposition time, salt bath concentration, HFCVD diamond growth parameters and HFCVD diamond deposition time was kept the same in each experiment for a better substrate steels comparative analyses. The films obtained were characterized by scanning electron microscopy field emission (SEM-FEG), X-rays diffraction, Raman spectroscopy and Rockwell C indentation test.