Optimization of wear protective DLC coatings by use of nanoindentation and Raman spectroscopy.

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Abstract
Hydrogen-containing DLC (a-C:H) coatings have been deposited by magnetron sputtering in an industrial setup equipped with graphite targets and the sputtering gas containing acetylene. To obtain optimum wear resistance, the C_2H_2 gas flow and the substrate bias voltage were systematically varied. The coating properties were characterized by nanoindentation, Rockwell C indentations and Raman spectroscopy. The nanoindentation yielded the hardness H and the Young's modulus E, and from the maximum H/E ratio the optimum wear resistance was found. The Rockwell C indentations characterized the adhesion qualitatively, and the Raman spectroscopy revealed the stress, the hydrogen content and the sp^3/sp^2 ratio. The hardness was found to be close to proportional to the stress. To improve the adhesion the stress was lowered – without lowering the hardness significantly – by annealing the coatings and/or doping with Cr, the latter introducing nanocrystalline carbide grains.

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