Improved tribological properties of carbon coatings by high power pulsed laser

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Abstract

For many applications in the field of cutting tools or watchmaking, the need to develop new solutions in order to improve the lifetime and performances of the components requires new approaches and solutions.
In a joint preliminary study between the Berner Fachhochschule (BFH) and the Haute Ecole ARC (HE-ARC), promising results have been achieved with nanotextured carbon layers produced using a hybrid technology. These coatings on steel substrates were obtained in two steps. First, a carbon coating is deposited by standard magnetron sputtering technology using a graphite target at HE-ARC. In a second step, the coating is treated at BFH with high power pulsed laser at a repetition rate of 100kHz which modifies the surface roughness and induced a nanotexture.

The pin-on-disc measurements performed in dry conditions on the textured graphite coating against a 100Cr6 steel ball showed that laser nanotexturing not only lowers the friction coefficient by 20-50% down to values between 0,10 - 0,18 but also eliminates the run-in phase and reduces wear by 50-100%.

This first study opens many possibilities to develop a new type of carbon-based coatings on 2D or 3D surfaces with sizes in the order of mm^2 to several cm^2 with modification by laser pulses for improved tribological performances.

Since the coating material is carbon, the maximum service temperature is around 400°C. These are first results; further optimization of the texture patterns is expected. Under lubricating condition, nanochannels with heights in the order of ~100nm are expected to be beneficial for storing of oil or water.