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New DLC coatings as enabler for the Mobility for Tomorrow for engine components

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The energy efficiency in internal combustion engines is a key factor for the reduction of CO_2-emissions of passenger cars and commercial vehicles. Diamond-like carbon (DLC) coatings in highly stressed engine components are therefore widely used for friction reduction and wear protection. One application is the valve train of the combustion engine due to its considerable frictional losses especially under boundary and mixed friction conditions at lower crankshaft speeds. In this regard, the tribological contact bucket tappet/camshaft in the valve train offers high potential for friction reduction but places also high demands on DLC coatings due to its complex kinematics and different contact pressures depending on the cam contours and the camshaft angle and speed. The aim of this work was to analyze the influence of the contact pressure on ultra-low friction behavior within the sliding contact ball-on-disc. This tribological contact was analyzed in a pin-on-disc tribometer using series-production DLC coated tappets (16MnCr5, AISI 5115) and steel balls (100Cr6, AISI 52100) ensuring same material pairing as in the real application. A synthetic oil PAO (polyalphaolefine) formulated with the friction modifier additive glycerol mono-oleat (GMO) was used for the tribometer tests. The influence of the contact pressure on the ultra-low friction behavior was tested as a function of the surface roughness under room temperature conditions (20 ± 1 °C) and a sliding velocity of 0,1 m/s. The wear of the superhard DLC coated functional surfaces was analyzed by means of confocal laser scanning microscopy (CLSM). The findings were correlated with the frictional behavior observed in the pin-on-disc tribometer. The results with friction coefficients lower than 0.02 and no visible wear reveal potential of DLC coating systems for energy efficiency as major enabler for the Mobility for Tomorrow.

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