The coating
Greater hardness of the a-C:H:Cr coating was achieved by increasing the chromium proportion. The contact angle as a measure of oil wetting properties could almost be halved in comparison with a-C:H (DLC), thereby boosting wetting capability considerably beyond that of uncoated steel despite the “Castrol Edge 5W30” oil being intended for uncoated steel. In the roller dynamometer for investigating friction coefficients, coating systems with 50 percent chromium have the best running-in characteristics – the coefficient of friction levels off at a very low figure of 0.05. Compared with uncoated steel this is equivalent to halving the friction coefficient.

Summary
Due to the higher proportion of chromium it was possible to develop a coating system which, on account of its great hardness, low coefficient of friction and optimum running-in characteristics, will be very suitable for use as a wear protection coating in internal combustion engines. Currently coating systems containing chromium are being tested in 100-hour tests on the roller dynamometer, in the pin-on-disk test and on the piston ring-cylinder test rig. Following investigations on the piston ring-cylinder test rig, the system will be tested in the real engine.

In the “TriboMan” inter-institute Fraunhofer research project, alloys, procedures and processes for manufacturing engine components are being developed. The objective is to achieve – even as early as the manufacturing process - permanent reductions in friction and wear due to the production-integrated pre-emption of the running-in process and the targeted creation of tribologically effective coating systems. In this project the Fraunhofer IST is concerned with developing, adjusting and optimizing the wear-resistant, hard and friction-reducing coating systems.

The coating
In order to achieve major reductions in oil and fuel consumption and significant increases in the service life and loadability of the engine components, hard and wear-resistant coating systems are being developed at the IST for bucket tappets, camshafts, piston pins or piston rings which have good running-in characteristics and optimum lubricant interaction. Current research is focusing on carbon film systems containing chromium (a-C:H:Cr) since their properties make them ideally suited for use in internal combustion engines:

- Extreme chemical resistance
- High temperature resistance, hardness, wear resistance
- Low coefficients of friction

TRIBOMAN – REDUCTION OF FRICTION AND WEAR IN INTERNAL COMBUSTION ENGINES

The greatest challenges faced by the automotive industry are to be found in achieving fuel savings and reducing emissions of the greenhouse gas CO₂, of which a high proportion is produced by internal combustion engines. Increasing mobility coupled with a thrifty use of fossil fuels can only be achieved by new generations of engines.

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Improvement of the friction coefficient $\mu$ in the roller against flat specimen test (oil: 90 °C, pressure 150 MPa, $V=2 \text{ m/s}$).

Improvement in oil wetting properties by increasing the proportion of chromium in the a-C:H:Cr.

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