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Economical engines due to less friction

Joint research project "Prometheus" further develops surface technology for lower CO₂ emissions

(Dresden, March 4, 2019) Together with the automotive industry, researchers at the Fraunhofer IWS have been working to develop processes for friction-reducing surfaces of engine components over the past few years. Now, carbon dioxide emissions can be reduced even further by enhancing surface technology. The Dresden Institute is researching in this direction with various partners in the joint project "Prometheus".

New diamond-like coatings and laser-structured surfaces will enable Dresden-based Fraunhofer researchers to significantly reduce CO₂ emissions of engines. Cars, trucks and buses, as well as construction machinery and gas engines, will consume less fuel and thus protect the environment. "In every engine, parts such as pistons and cylinders slide against one another. The more frictional heat is generated, the more fuel is consumed and the higher are the CO₂ emissions," explains Dr. Volker Weihnacht, who heads the research project at the Fraunhofer Institute for Material and Beam Technology IWS in Dresden. The aim is to optimally balance surface and lubricant in order to reduce friction.

Surface and lubricant need to harmonize

"Currently, super hard, diamond-like carbon coatings already exist. We have optimized these further and added various elements to the graphite evaporated by the plasma process." At the same time, scientists are also developing a laser microstructuring process, giving the respective surfaces a kind of shark skin effect and thus improving their sliding properties, adds Weihnacht. The interaction of the components is particularly important during development: "There is no ideal lubricant and there is no ideal surface coating and structure. It is more important to bring everything into harmony with each other and that in interaction between the various engine components," says Dr. Volker Weihnacht, explaining the challenge and adds: "These are the levers we are turning.

According to current scientific knowledge, the carbon layers produced at IWS under the brand name Diamor® have the greatest potential for reducing friction and wear.

Head of Corporate Communications

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They consist of up to 70 percent diamond bonds and are produced using the laser arc process specifically developed for these coatings.

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Collaboration with different partners

In order to find the optimum balance between lubricant and surface, the Fraunhofer scientists work closely with engine and component manufacturers as well as material and lubricant experts. A total of twelve partners from industry and research are involved in the "Prometheus" joint research project sponsored by the German Federal Ministry of Economics and Technology. The project was officially launched at the beginning of January 2019 and will run for three years. At the end of the project, low-friction engine parts are to be prototyped and transferred to industrial series production just a few years after the end of the project. "With our developments, we are moving a major step towards lower-consumption combustion engines for a wide variety of applications," says Dr. Volker Weihnacht, who can visualize many other applications thanks to the experience gained. It is conceivable, for example, that the solutions found could be used not only for rolling bearings but also for plain bearings such as those used in pumps.

The **Fraunhofer-Institut für Werkstoff- und Strahltechnik IWS Dresden** stands for innovations in laser and surface technology. As an institute of the Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e. V., IWS offers one stop solutions ranging from the development of new processes to implementation into production up to application-oriented support. The fields of systems technology and process simulation complement the core competencies. The business fields of Fraunhofer IWS include PVD and nanotechnology, chemical surface and reaction technology, thermal surface technology, generation and printing, joining, laser ablation and separation as well as microtechnology. The competence field of material characterization and testing supports the research activities.

At Westsächsische Hochschule Zwickau, IWS runs the Fraunhofer Application Center for Optical Metrology and Surface Technologies AZOM. The Fraunhofer project group at the Dortmunder OberflächenCentrum DOC® is also integrated into the Dresden Institute. The main cooperation partners in the USA include the Center for Coatings and Diamond Technologies (CCD) at Michigan State University in East Lansing and the Center for Laser Applications (CLA) in Plymouth, Michigan. Fraunhofer IWS employs around 450 people at its headquarters in Dresden.

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Using novel diamond-like coatings and laser-structured surfaces, researchers at the Fraunhofer IWS aim to significantly reduce CO₂ emissions from engines. For example, the Diamor® coating developed at the Dresden Institute could contribute to this by reducing friction in the engine cylinder between the coated piston pin (pictured) and the connecting rod bushing.
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The more frictional heat generated, the more fuel consumed and the higher the CO₂ emissions. Coated piston rings seal the cylinder against the liner in the combustion chamber and have high potential to reduce friction when sliding against the cylinder wall.

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