Healing Pigments Against Corrosion

Corrosion shortens the service life of metallic surfaces on aircraft and automobiles. The VIPCOAT project (Virtual Open Innovation Platform for Active Protective Coatings Guided by Modeling and Optimization), which is funded by the European Union, is looking for new solutions for corrosion protection.

Corrosion is more than rusting: it is the electrochemical reaction of base metals with oxygen or other components from the environment. To stop this process, chromates are used in aerospace, for example, but they are toxic, carcinogenic and harmful to the environment. In the search for chromate-free alternatives, the Fraunhofer ITWM contributes its expertise in the two departments "Optimization" and "Image Processing".

Project Manager Dr. Natalia Konchakova (HEREON) visited Dr. Katja Schladitz (left) and Dr. Peter Klein at the Fraunhofer ITWM.

Turning Pollutant into Advantage

The outer skin of aircraft is damaged by stone chipping, for example, and thus suffers cracks and scratches through which water penetrates. This leads to corrosion. "The idea: to turn water as a source of danger into an advantage, namely by using anti-corrosion pigments that react with water and release ions that close the crack," says Dr. Katja Schladitz from the "Image Processing" department. With each scratch, channels are created through which the water flows in, but also out again. In the process, it dissolves the anti-corrosion pigments consisting of salts from the coated outer skin of the aircraft and repairs it layer by layer. The crack virtually closes itself when the aircraft is left in the rain for a certain period of time. "Active-reactice" is the name given to this mechanism.

The VIPCOAT researchers want to find out exactly how the optimal layer is composed by reproducing the microstructure of chromate-free coatings, including the transport channels, and optimizing the composition. Information about the size, shape and arrangement of the corrosion inhibitors is obtained from 3D images taken at the German Electron Synchrotron (DESY) in Hamburg.

Detect Particles

The preparation of the paint samples and their 3D imaging are complex because the particles are very small. In order to correctly capture their shape, one has to resolve them extremely high. This end very small samples (100 µm diameter) have to be prepared and placed stably for measurement. In the resulting 3D images, the particles have to be identified. This step is also complex because the sizes vary greatly, but the gray values of different types of particles are sometimes identical or do not differ significantly from that of air.

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