Glass sensors measure weathering effects

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The corrosiveness of a specific atmosphere can be established in a few weeks by thin slices of special glass. The sensors are capable of monitoring the outdoor environment as well as indoors, for instance in sensitive production processes such as chip fabrication.

Where does a Landrover develop rust faster: in the dusty Sahara or parked in front of an English stately home? The answer's obvious: In rainy Britain of course. But the rate at which corrosion sets in is not only dependent on precipitation. It also involves other factors like humidity and temperature, and the concentration of air pollutants such as nitrogen oxides and sulfur compounds. Traditionally, each of these parameters is measured separately, making it difficult to predict their corrosive effect, because this depends on the interaction of all variable factors. Scientists at the Fraunhofer Institute for Silicate Research ISC have developed a glass sensor that allows the complex effect to be calculated even before the vehicle starts to rust. The manufacturing process for the glass sensor has been validated according to German VDI guideline 3955/2.

The glass plates have a polished surface that is highly sensitive to corrosion. "This allows us to detect changes long before the exposed materials or objects show any signs of damage," explains Hannelore Römich, head of the department for conservation of historical artifacts. The researchers place the glass sensors in small holders at the site in question. A few weeks later, they collect the plates and analyze them using infrared spectroscopy. This allows them to quantify any changes in the composition of the glass. From these data, they can extrapolate the probable damage to other inorganic materials such as stone or metal, and

identify the specific pollutants responsible for the corrosion. By examining the plates under a microscope, the scientists can also tell whether microorganisms play a role in the weathering process.

“The sensor has already been employed to good effect on historic monuments, stained-glass windows and in museums,” reports Hannelore Römich. “In each case, the thin glass plates were extremely useful in helping to improve the conditions needed to preserve the works of art.” The researchers recently took measurements at the DaimlerChrysler site in Sindelfingen near Stuttgart, to determine whether the air in the vicinity of the carmaker’s world-largest production plant is too corrosive. A false assumption, as the sensors proved. The inventors of this simple test also see other potential applications, for instance monitoring the air in chip-fabrication facilities, where a corrosive atmosphere would damage the delicate components. To make this possible, the researchers have improved the sensitivity of the sensor. Special coatings make it three to ten times more sensitive and hence faster.

Source: Fraunhofer-Institut für Silicatforschung