Playing snooker with atoms

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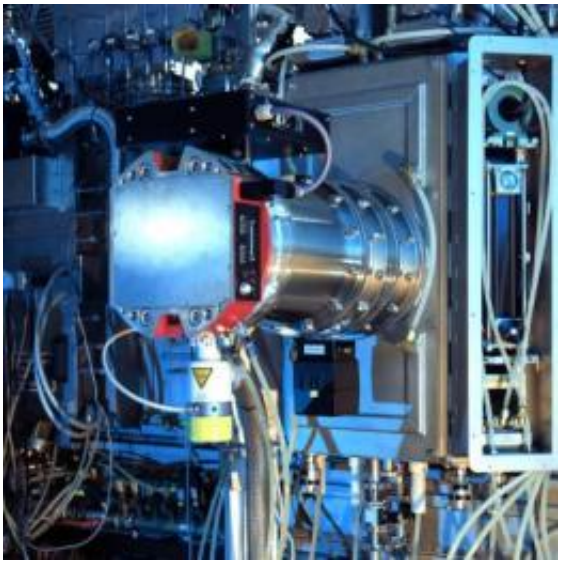

The new coating module enables IST researchers to produce previously unattainable combinations of materials. Credit: Fraunhofer IST

Scientists speak of sputtering when energy-rich ions hit a solid object and cause atoms to be released from its surface. The phenomenon can be exploited to apply microscopically thin coatings to glass surfaces. A German research team has developed a special sputtering technique that greatly increases the efficiency of the coating process.

Designed to be the most spectacular concert hall in Germany, the construction of the Elbe Philharmonic Hall in Hamburg is a controversial project, but it is already creating a sensation in the architectural world. Nobody has ever tried to build windows this high,

each one five meters tall, of unique dimensions, and glazed with multifunctional insulating glass. The demands on the architectural glass used in modern structures like this are increasing all the time. Quite apart from their large surface area, they also have to offer outstanding optical characteristics and at the same time a high quality of thermal and sound insulation. These qualities depend to a large extent on their surface coating. And this has become a costly challenge.

Researchers at the Fraunhofer Institute for Thin Film and Surface Technology IST in Braunschweig have developed a new module for a sputtering plant that significantly increases the efficiency of the coating process. Sputtering is the preferred process for coating large surfaces. The process leads to an bombardment of a chosen material (target) and causes its constituent atoms to be ejected like billiard balls by the impact of the energy-rich ions - generally noble-gas ions. The latter subsequently condense on the surface of the glass or other substrate to form a thin film with specific properties depending on the characteristics of the starting material. Different designs are possible for the coating module. The version that consists of two rotating tubes containing strong magnets is referred to as a double magnetron. The magnets increase the sputtering rate, but severely limit the options available to the design engineers: "We can only sputter materials for which targets are available and can be produced," explains IST department head Dr. Bernd Szyszka. "Moreover, the sputtering process we have been using up to now is inefficient, because only a fraction of the bombarding ions actually contribute to the sputtering effect. More than 95 percent of their energy is lost in the water-cooling system."

The IST experts have overcome this obstacle by placing an additional flat target made of a heavy element such as bismuth behind each target tube. "This significantly increases the sputtering rate," says Szyszka. The ionized noble gas causes bismuth atoms to be released from the flat solid body. These atoms are gradually "implanted", as the experts say, in the

tube target. As the researcher confirms, "The bismuth has enabled us, for example, to significantly improve the deposition of titanium dioxide." The quantity of coating material removed from the target is increased. The IST researchers have meanwhile scaled up this effect to industrial level. "Using a simulation program, we were able to optimize the sputtering process in terms of material deposition on the flat and tube targets, even before we had built the new prototype model. We are now able to combine the target materials in any way we desire, without causing unwanted chemical reactions on the surface."

The result is a higher deposition rate and a more homogenous surface coating based on new materials that previously could not be produced. It also takes less time to produce the coating, reducing the energy consumption. "The new coating technology has allowed us to replace three old magnetrons with two new ones. The system is much cheaper to operate and produces materials with improved properties," says Szyszka. The researchers will be present at the Glasstec fair in Düsseldorf from September 28 to October 1, presenting a wide range of applications from panoramic car roofs that provide thermal insulation to photovoltaic cells with improved efficiency. "This is the start of a new revolution in large-area coatings," promises the scientist.

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