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Extract from the annual report 2011
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IMPROVED COATING ADHESION ON PTFE BY MEANS OF PLASMA TREATMENT

RF-sputtered polytetrafluoroethylene (PTFE) coatings are highly transparent, have a low refractive index (n = 1.39) and are very elastic. Unfortunately other coatings deposited on PTFE adhere only very poorly. The aim of the development work carried out at the Fraunhofer IST was to improve coating adhesion on PTFE surfaces. This opens up new areas of application, such as, for example, optical coating systems or composite organic/inorganic coatings.

Experimental approach

Organic materials such as polymers are normally not suitable for deposition via sputtering methods since their electrical conductivity is too low and their molecular structure too sensitive for the high particle energies of a gas discharge plasma. PTFE is an exception here and at the Fraunhofer IST it is deposited with a conventional sputtering magnetron in a pure argon atmosphere. To improve adhesion on PTFE coatings the sputtering chamber used (Fig. 1) was modified so that the substrates could be treated with plasma with an RF power feed between two coating processes. To enable the following investigations into adhesion the PTFE layer was coated with tantalum oxide in the next step. Adhesion of Ta_2O_5-layers was successfully optimized by varying different treatment parameters, such as duration of treatment, atmosphere and RF power.

Results

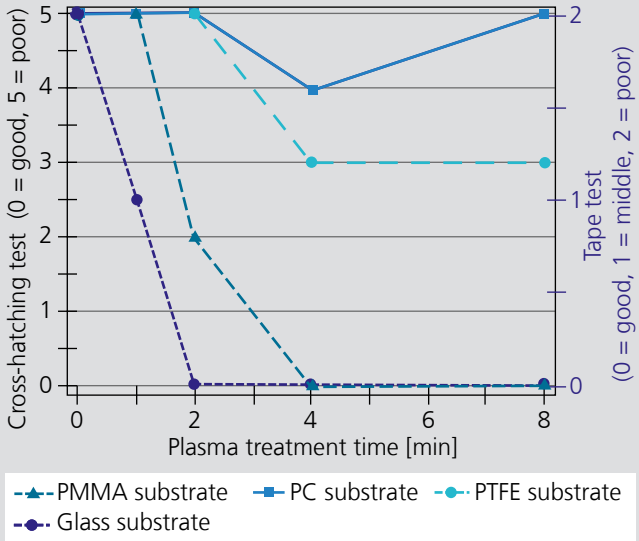
The PTFE surface is etched by ion bombardment during plasma discharge. It is worth noting that the etching rate depends closely on the composition of the process gas. In pure argon the plasma-etched coating thickness in the PTFE is proportional to the duration of treatment. The addition of 5 percent hydrogen to the process gas results on the other hand in a slight increase in thickness (bottom graph). The refractive index of the layers rises slightly, which is attributable to fluorine being replaced by hydrogen at the PTFE surface. Coating adhesion, which was measured by the cross-cutting adhesion test as specified in DIN EN ISO 2409 and also by a simple tape test (on glass substrates), improves considerably even after just a few minutes of treatment.

Outlook

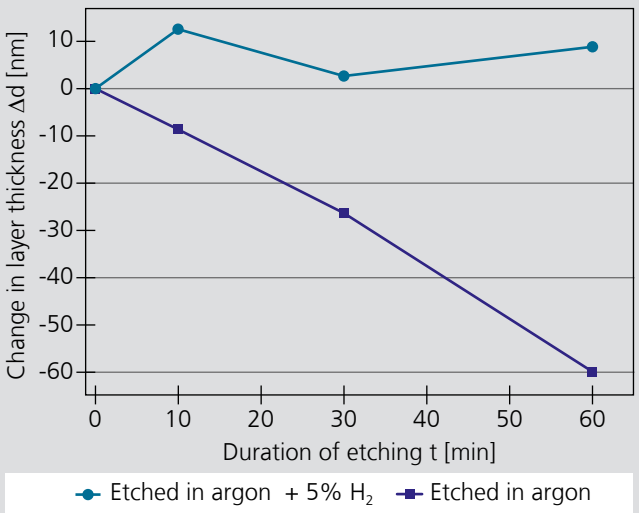
The plasma treatment of PTFE coatings and substrates in an atmosphere containing hydrogen is a promising way of creating good coating adhesion. It becomes possible to use PTFE coatings even in optical and other layer stacks and new kinds of applications will open up.

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Adhesion as a function of treatment time.



Change of thickness as a function of treatment time.



1 *Sputtering chamber used for the experiments.*

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