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Plasma Hardening of Sol-Gel Coatings

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Sol-gel deposition is a common way to apply functional nm- and μm -coatings onto a broad range of materials. By adapting the chemical composition of the precursor solution, the resulting surface properties can be tuned, like wettability, easy to clean behaviour, gas permeability, corrosion protection or scratch resistance.

State-of-the-art technologies for hardening of sol-gel layers are either heat treatment or UV- irradiation. In case of thermal annealing the applied temperature and dwell time are dependent on the sol type and the substrate material. For a TEOS sol common post-treatment conditions are e.g. 2h storage at temperatures above 100°C or more.

An alternative possibility for sol-gel layer hardening is the application of atmospheric pressure plasmas. The plasma mixture of reactive species, radiation from UV until infrared and thermal energy leads to the hardening of sol-gel coatings after short times, like seconds.

Two different plasma sources were tested successfully for this application, a plasma jet and a surface dielectric barrier discharge. In dependence of the used plasma source and the treatment parameters sol-gel coated temperature-sensitive materials can be treated as well as coated glasses and metals.

The effect of sol-gel hardening was verified by FTIR-spectroscopy. Changes in chemical bondings (network formation) and their relative absorption intensities are indicating the hardening effects. Thus, a comparison between different hardening technologies is also possible.

Besides the thin film analytic, optical emission spectroscopy (OES) was carried out to evaluate the plasma composition.

OES- and FTIR-results help to optimize the plasma hardening of sol-gel coatings.

These plasma techniques are especially suited for areal (preferably flat), linear or local treatments.

Keywords

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Hardening of coatings

FTIR & OES