

PO1028

## **Residue Free Removal of Organic Contaminants on Micro Structured Surfaces by Use of an Atmospheric Pressure Plasma**

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We report on an atmospheric pressure plasma-based cleaning process of nano structured gold surfaces, which prior had been contaminated by low quantities of organic substances. The used contaminants are highly resistant against various solvents, furthermore the surface is structured with inverted pyramids of 2µm side length and therefore fragile to direct contact. For that reason it has to be cleaned contactless. The plasma treatment with a dielectric barrier discharge (DBD) reduced the contamination by 40% after 30 seconds and beneath the detection limit of the used laser/spectrometer combination after 120 seconds. The cleaning effect was analysed by energy dispersive X-ray spectroscopy (EDX) and Raman spectroscopy. The use of a plasmonic surface can amplify the Raman scattering by  $10^{11}$  and therefore allows to detect single molecules of a species adherent to the surface. Analysis of the surface with atom force microscopy has shown that the structured surface is not damaged by the treatment, which allows reutilisation of the substrate.

The cleaning effect is explained by a combination of physical and chemical effects, where the energized electrons break chemical bonds of the contaminants by impact dissociation and in the discharge produced atomic oxygen, which is highly reactive, works as a solvent for the organic substances, whereby the substances are removed from the surface (and near surface area) by diffusion.

It was demonstrated, that highly fragile surface structures can be cleaned by an atmospheric pressure plasma, leaving no detectable residues.

### **Keywords**

plasma cleaning  
dielectric barrier discharge  
raman spectroscopy  
surface treatment