Nanostructured glass substrate for SERS detection and characterization of micro and nanoplastics

Matteo Giardino[1,2*], Davide Luca Janner[1,2]

[1]Department of Applied Science and Technology (DISAT), Politecnico di Torino, c.so Duca degli Abruzzi 24, 10129 Torino
[2]Consorzio Interuniversitario Nazionale per la Scienza e Tecnologia dei Materiali, v. G. Giusti 9, 50121 Firenze
*presenting author: matteo.giardino@polito.it

Microplastics are defined as plastic particle fragments whose size is below 5 mm, whereas nanoplastics have dimensions laying in the range between 1um and 1nm.

Characterization of nanoplastics by traditional Raman microscopy is a tedious task due to the small size and low concentration in real samples, and therefore thedue to their weak scattering intensity, of these samples.

Surface Enhanced Raman Spectroscopy (SERS) is a variant of the Raman spectroscopy in which a metallic nanostructure is exploited to obtain a local enhancement of the electromagnetic field resulting in a sensible increase of the Raman cross-section.

It represents an interesting approach for detecting analytes in low and ultra-low concentrations, and recentlythe detection of analytes in low and ultra-low concentrations and, recently, it has also been applied to the study of micro and nano plastics.

We hereby propose a new type of SERS sensor based on a pillar nanostructured glass coated with a thin film of metals exhibiting plasmonic properties, such as gold and silver.

The pillar nanostructures are obtained by deposition of a copper nanoparticles shadow mask on the glass substrate, and its subsequent processing by reactive ion etching (RIE) in a CF_4 and Ar atmosphere.

The glass is finally coated with a gold or silver layer of thickness in the range between 20 and 60nm by means of RF sputtering.

Polystyrene micro and nano beads were chosen as an analytical model of micro and nano plastics, and the sensitivity of the different sensors showed promising results for the detection in a Raman microscope at different excitation wavelength.