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From micro to nano Raman: new developments in the detection of micro and nanoplastics of marine origin from the Amazon basin to Santos

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Highlights

New analytical techniques are in place for determining nanoplastics pollution i.e., addressing chemical functionality and providing structural information with high spatial resolution.

Resumo/Abstract

The environmental accumulation of nanoplastics formed by material of anthropic origin has raised doubts about their safety, especially to the human body. While microplastics are accidentally consumed, nanoplastics (NPs) are even more concerning as they are much more likely to be absorbed by human body cells. It is known that plastics smaller than 200 nm can penetrate cell membranes and cross the blood-brain barrier. Studies have shown that polystyrene (PS) NPs from the environment carry a high load of toxins capable of compromising human brain cells. Very little is still known about what effects, cytotoxic or not, these plastics have on different organs. Understanding the property-function relationship of nanoparticles in various fields of application involves determining their physicochemical properties, which is still a formidable challenge to date. Our project focuses on the development of a methodology for the detection of micro- and NPs using micro-Raman, TERS (Tip Enhanced Raman Spectroscopy), collinear Raman and AFM, nuclear techniques, as well as a methodology for in vitro evaluation of the toxic effects of these materials through biochemical assays of cytotoxicity and genotoxicity. The project contemplates the determination of the adsorption capacity of metallic ions by NPs and the absorption of micro- and nanoplastics in cell cultures with radioactive tracers, the determination of microplastics in tissues from necropsies of marine animals and gamma spectroscopy of the cellular incorporation of NPs labeled with radioactive isotopes.

In figure 1 we show examples of (a) the detection of microplastics from the Santos basin and comparison to Raman reference database (KnowItAll®), (b) detection of NPs in mouse fibroblast cells and (c) detection of very small particles (50 nm) which can be achieved by co-localized techniques of AFM + Raman using special, narrow (50 μm), femtosecond laser written gratings on quartz.

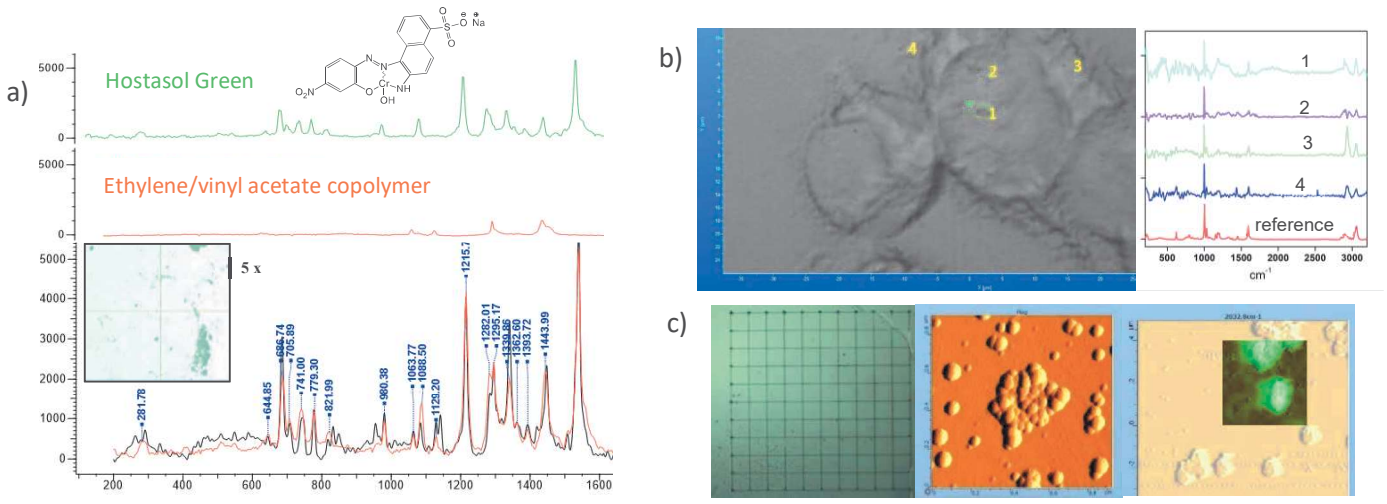

Figure 1: (a) Raman spectra of a micro-copolymer with pigment; (b) detection of 200 nm PS in cell culture; (c) detection of 50 nm nanoplastics

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