November 12-13 2024
RamanFest
Paris | FRANCE

Karlo Maškarić[1,2,3]
Ioana Marica[1,2,3], Ion Nesterovschi[1,2,3], Iuliana-Cornelia Poplăcean[1,2], Lucian Barbu-Tudoran[3,4], Tudor-Liviu Tămaș[5], Simona Cîntă Pînzaru[1,2]*
[1]Babeş–Bolyai University, Biomolecular Physics Department, Kogălniceanu 1, 400084 Cluj-Napoca, Romania
[2]RDI Institute in Applied Natural Sciences, BBU, Fantanele 30, Cluj-Napoca, Romania
[3]National Institute for RD of Isotopic and Molecular Technologies, Donath 67-103, 400293 Cluj-Napoca, Romania
[4]Electron Microscopy Center, Babeș-Bolyai University, Clinicilor 5-7, 400006 Cluj-Napoca, Romania
[5]Department of Geology, Babeș-Bolyai University, M. Kogălniceanu 1, 400084 Cluj-Napoca, Romania
simona.pinzaru@ubbcluj.ro, karlo.maskaric@ubbcluj.ro

Blue, naturally aged polypropylene in aquatic environment as a SERS label: prospect for AgNPs adsorption and its complexes

Detecting and characterizing microplastic particles with normal Raman spectroscopy is usual practice for environmental water samples [1,2]. The possibility of SERS as a tool to detect nanoplastics [3] inspired us to synthesize micro- and nanoplastic particles (MNPs) derived from years-aged blue polypropylene plastic (PP), coated with silver nanoparticles (AgNPs) from a modified Lee-Meisel procedure [4]. We aim to elucidate the interaction between AgNPs and blue PP MNPs, and to draw conclusions on the influence of the blue pigment (PB15) incorporated in plastic in the overall SERS capability to detect and quantify nanoplastic in environmental waters. In addition, X-ray diffraction was used to check the aged PP crystallinity and correlate it with plastic age and pigment integrity. Characterization of the AgNP colloid obtained in the presence of MNPs plastics was performed with UV-Vis and SEM/TEM. The evaluation of the PB-15 persistence in MNPs PP was done with resonance Raman spectroscopy to selectively detect the PB15 in <μm size particles inside AgNP colloid solution, as well as the bulk normal Raman spectroscopy of AgNP colloid containing plastics. Further validation of persistence of the pigment is evaluated via drop coated Raman deposition (DCDR). Plastics coated with AgNP were evaluated for SERS enhancement using crystal violet (CV) and methylene blue (MB) as test molecules for μM concentrations, revealing unaltered enhancement compared to the classical AgNPs. Thus, the approach allowed improved capability of SERS for blue, environmentally abundant nanoplastic screening.

References

[1] I. Nesterovschi et al., Spectrochim. Acta A Mol. Biomol. Spectrosc., (2023), 298, 122811.
[2] I. Chakraborty et al., Int. J. Environ. Sci. Technol. (2023), 20, 10435–10448.
[3] I. Marica, S. Pinzaru et al, (2024), Environmental Science: Nano, Under review.
[4] P.C. Lee et D. Meisel, J. Phys. Chem. (1982), 86, 3391–3395.

Figures

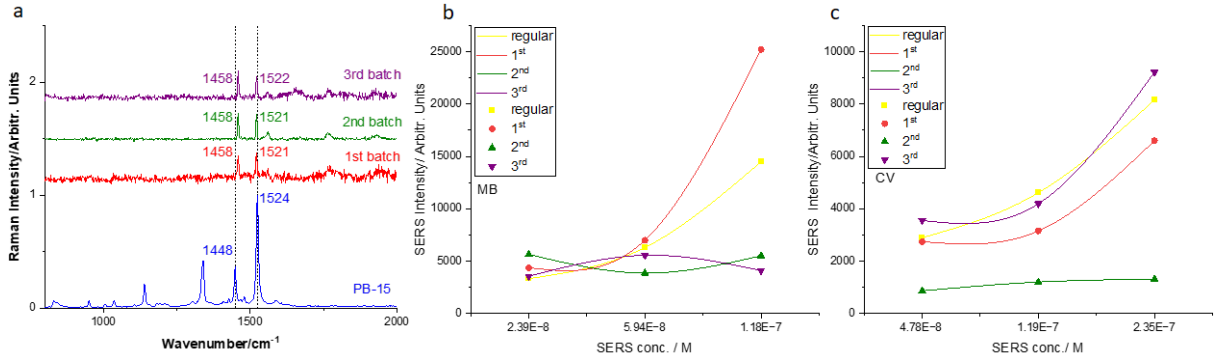

Figure 1: a) PB-15 persistence in AgNP colloid, SERS absolute intensity as a function of the SERS concentration of the analyte b)CV c) MB