Experimental report

06/09/2022

Proposal: 9-10-1653 **Council:** 4/2020

Title: Polystyrene interaction with modelmembranes

Research area: Soft condensed matter

This proposal is a resubmission of 9-13-893

Main proposer: Elena DEL FAVERO

Experimental team: Giovanna FRAGNETO
Elena DEL FAVERO
Caterina RICCI

Local contacts: Thomas SAERBECK

Samples: Dipalmitoylphosphatidylcholine

Instrument	Requested days	Allocated days	From	To
D17	3	1	16/09/2020	17/09/2020

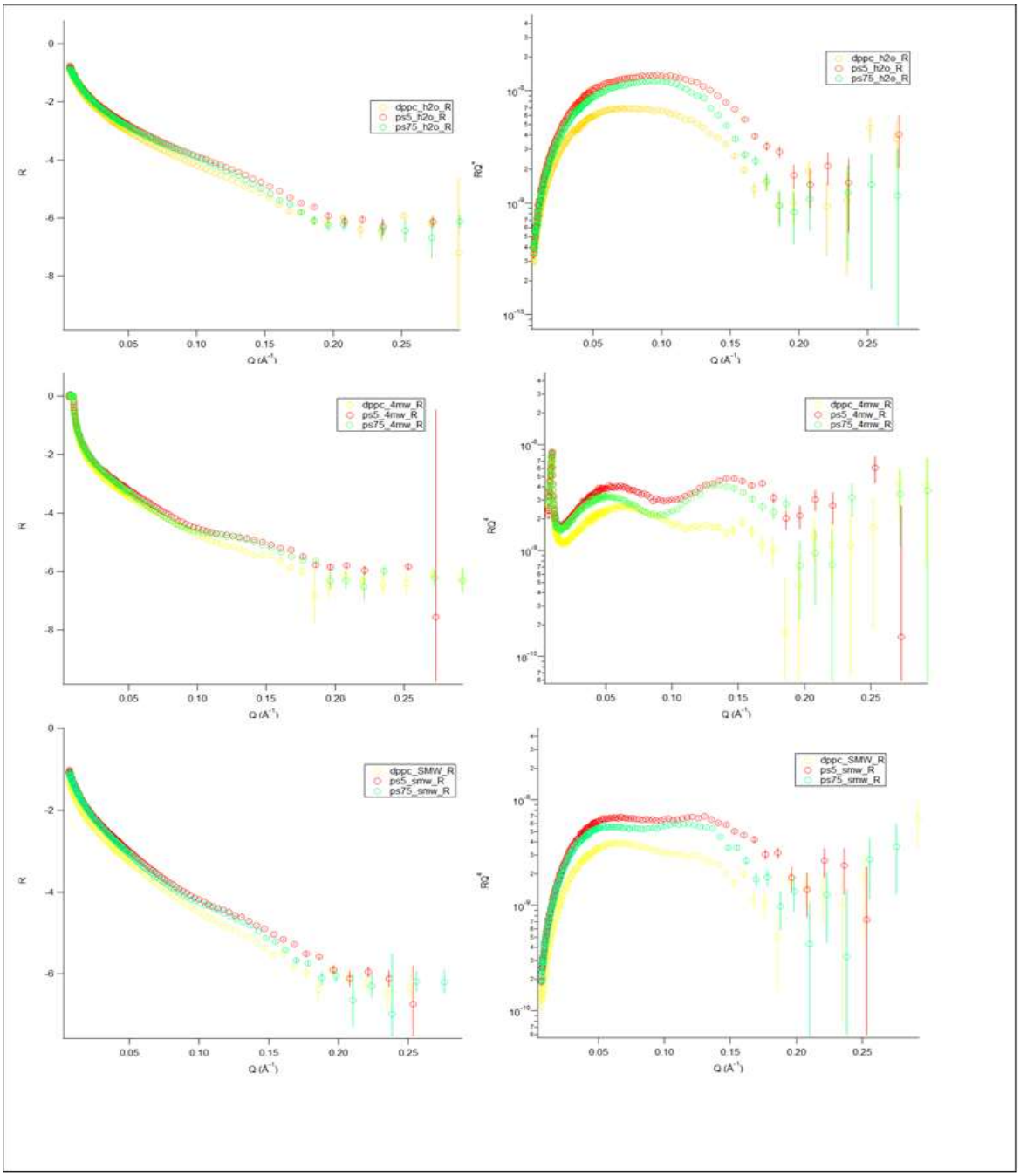
Abstract:

Micro e nanoplastic fragments are expected to persist in the marine environment for centuries, with toxic effects on living organisms. Characterizing the interaction of plastic nanoparticles and polymers with membranes is the first step towards the understanding of the physical and chemical basis for their toxicity. Nonetheless, so far, only computational studies with molecular resolution have investigated the effects of nanoplastics and polymers on model cell membranes. Our aim is to study the interaction of polystyrene with different biomimetic model membranes by neutron reflectometry to investigate the disposition of polymer chains in the lipid core as a function of their length and mole fraction.

Report- Experiment n°9-10-1653

Polystyrene interaction with model membrane

For years the exploitation of plastic-made arifacts has been considered inert and zero impact as well as beneficial from a sanitary point of view. Recently, in addition to the problems related to its disposal, more and more evidence has emerged of an interaction of microplastic particles with living organisms at the cellular level. Biological membranes are the first barrier encountered by particles foreign to the cell. A physicochemical characterization of the effects of synthetic polymers on the structure and dynamics of cell components is the first step towards understanding the basis for their toxicity in all living organisms. We already observed that doping doses of short chains of polystyrene (25 monomers) alter the thermal and structural properties of DPPC model membranes, in a concentration-dependent fashion [1]. Our aim was to study the interactions between short chains of polystyrene (25



monomers) and model lipid membranes (dipalmitoylphosphatidylcholine DPPC, in both gel and fluid

phase). We found that polystyrene oligomers alter the thermal properties of DPPC, stabilizing the fluid lipid phase.

Short chains of polystyrene perturb the membrane structure and dynamics, in a concentration-dependent fashion. Eventually, they modify the mechanical properties of DPPC, reducing its bending modulus in the fluid phase.We now performed Neutron Reflectometry NR experiments (9-10-1653, 1 day allocated on D17) on bilayers of dDPPC (deuterated chains): polystyrene PS (short chains, 25 monomers) at two different relative concentrations (10:0.5 w/w and 10:0.75 w/w) in three contrast solutions.

Mixed membranes were prepared by the thin film hydration method, first dissolving lipids and polystyrene in chloroform, then removing the organic solvent in order to obtain a thin lipid film to be rehydrated.

We observed the modification of the intensity profile upon the incorporation of PS. The increasing amount of PS (25-monomers) leads to an increasing effect in the membrane, that can be observed in all the three different contrasts.

Further analysis is in progress to identify the position of the polystyrene in the layer.

1. Bochicchio, D. et al. Interaction of Hydrophobic Polymers with Model Lipid Bilayers. *Sci. Rep.* **2017**, *7*.