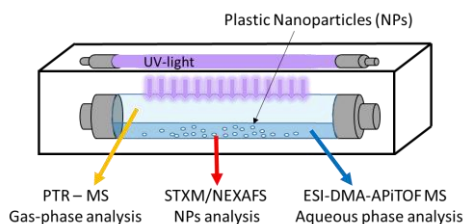


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Previous studies have shown the ubiquitous presence in the biosphere of microplastics (MPs), plastic fragments with size lower than 5 mm, due to years of improper disposal of plastic materials, mismanagement and negligent littering. Only recently, the presence of nanoplastics (NPs) in oceans and in atmospheric particulate matter has been demonstrated [1,2] and it is still unclear what their environmental impact could be. NPs have size lower than 1 $\mu$ m and, due to their density, they are expected to float at the surface of the oceans and interact with both atmosphere and bulk water. Moreover, NPs can absorb sunlight and react with oxidants in the gas and in the liquid phase. Most studies focus on surface modification using different approaches, mainly based on infrared spectroscopy (FT-IR, ATR, ...) or on microscopy (AFM, SEM, ...). However, as far as we know, little information is reported concerning degradation and photodegradation products released in both aqueous and gaseous phase. It is worth noting that NPs and MPs degradation in the aquatic environment can release soluble compounds that could have an impact on DOM (dissolved organic matter).

At first, we investigated interaction between PS-NPs (polystyrene nanoparticles) and light or ozone, using commercially available NPs. The suspension in MilliQ water was a) irradiated with UVC lamps or b) exposed to an air flow containing 400 ppb of ozone. A significant uptake of ozone into the PS-NPs was observed, also for short-term exposure (19h). This result highlights that NPs at the water surface can interact with oxidants in the gas phase, such as ozone. PS-NPs were also analyzed by STXM/NEXAFS (scanning transmission X-ray microscopy coupled to near-edge X-ray absorption fine structure spectroscopy) in order to investigate chemical modifications [3].

Experiments a) and b) show a general increase of oxygenated functionalities, confirming that PS-NPs dispersed in water react with both light and ozone. STXM/NEXAFS also revealed to what extent the conjugated bonds on PS-NPs decayed. Indeed, analysis of the overlying gas-phase composition evidenced the formation of benzaldehyde and butanal.

Since polystyrene represents less than 10% of the world plastic demand [4], the degradation of different NPs particles was investigated in aquatic environment. Commercially available NPs and MPs were dispersed in Milli-Q water and were exposed to UV light (355 nm) in the presence and in the absence of 1mM hydrogen peroxide. The buildup of degradation compounds induced by direct light absorption, reaction with photogenerated hydroxyl radicals or hydrogen peroxide, was studied by ESI-DMA-APiTOF MS (electrospray ionization – differential mobility analyser – atmospheric pressure interface time of flight mass spectrometry). For all the investigated NP polymers, degradation leads to formation of small organic molecules (formate and acetate) and of compounds with molecular mass up to 200 Da. We do not observe in the mass spectra higher weight (>200 Da) compounds derived by the breakup of large segment of the polymer chain. Therefore, these preliminary results suggest that polymer oxidation takes place little by little at the chain extremities but further investigations are needed to confirm this hypothesis.

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