Exploring the potential of photoluminescence spectroscopy for the detection of microplastics

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Abstract

The presence of Micro and Nano-plastics (MNPs) in various matrices has been of serious concern in recent years and thus there is a dire need for reliable technologies to detect, characterize and eliminate these MNPs pollutants from water, food, and beverages, as well as other matrices. To date both FTIR and Raman spectroscopies are typically used for their identification, however, photoluminescence (PL) spectroscopy has recently emerged as an efficient alternative (1). A recent study demonstrated the auto-fluorescence-based detection of microplastics through the use of a single excitation wavelength without any contrasting agent (2). In the work presented here, the PL emission spectra at the excitation wavelength of 360 nm for three different microplastic polymers are studied: polystyrene (PS), polyethylene terephthalate (PET), and polypropylene (PP). The different microplastics exhibit different PL spectral features (Fig.1) that enable their identification of microplastics. The spectrum for PS shows a broad emission peak split into three distinct wavelengths of emission maxima (λem) at 385, 405 and 425 nm with a minor shoulder at 455 nm (Fig. 1(a)), whereas for PET, it shows a more symmetrical emission with λem at 390 nm and 415 nm (Fig. 1(b)). In comparison to those, the spectrum for PP shows a dominant emission wavelength λem at 405nm associated with a broad emission (from 425 nm to 600 nm) that contains many peaks (Fig. 1(c)). It is postulated that the origin of these emissions may be due to the monomer and excimer emissions of the different polymer microplastics (3). The chemical structure and the presence of various functional groups of different microplastics were confirmed by Raman spectroscopy. The study, therefore suggests that PL spectroscopy has a promise to detect and discriminate different microplastics from each other.

Keywords: Microplastics, photoluminescence spectroscopy, fluorescence sensing

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