Contribution ID: **1067** Type: **Poster Presentation**

Lanthanide metal-organic frameworks as ratiometric fluorescent probes for real-time monitoring of PFOA photocatalytic degradation process

The assessment of perfluorooctanoic acid (PFOA) photocatalytic degradation usually involves tedious pretreatment and sophisticated instrumentation, making it impractical to evaluate the degradation process in real-time. Here-in, we synthesized a series of lanthanide metal-organic frameworks (Ln-MOFs) with outstanding fluorescent sensing properties and applied them as luminescent probes in the photocatalytic degradation reaction of PFOA for real-time evaluation. As the catalytic reaction proceeds, the fluorescence color changes significantly from green to orange-red due to the different in-teraction mechanisms between the electron-deficient PFOA and smaller ra-dius F- with the ratiometric fluorescent probe MOF-76 (Tb: Eu=29:1). 1 The limit of detection (LOD) was calculated to be 0.0127 mM for PFOA and 0.00746 mM for F-. In addition, the conversion rate of the catalytic reaction can be read directly based on the chromaticity value by establishing a three-dimensional relationship graph of G/R value-conversion rate-time (G/R in-dicates the ratio between green and red luminance values in the image.), al-lowing for real-time and rapid tracking of the PFOA degradation. The recov-eries of PFOA and F- in the actual water samples were 99.3-102.7% (RSD=2.2-4.4%) and 100.7-105.3% (RSD=3.9-6.8%), respectively. Both the-oretical calculations and experiments reveal that the detection mechanism was attributed to the photoinduced electron transfer and energy transfer between the analytes and the probe. This method simplifies the sample analy-sis process and avoids the use of bulky instruments, and thus has great po-tential on the design and development of quantitative time-resolved visuali-zation methods to assess catalytic performance and reveal mechanisms.

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Session Classification: Poster

Track Classification: (MS22) Manufactured Porous Materials for Industrial Applications