Mixed Eu$^{3+}$-Tb$^{3+}$ Metal-Organic Frameworks build on Isophthalic acid ligand as Ratiometric Luminescent Thermometer

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Metal-Organic Frameworks are crystalline and porous hybrid materials built-up from metal ions as nodes linked by bridging ligands. They have attracted great interest due to their versatile chemistry, high surface areas and chemical functionality. Recently, lanthanide-based luminescent MOFs (Ln-MOFs), whose optical properties may come from the organic or inorganic part, have emerged as luminescent thermometers. Indeed, compared to conventional thermometers, luminescent thermometers have unique and distinct advantages of fast response, high accuracy, non-invasive nature, high spatial resolution characteristics at the submicron scale where traditional methods are ineffective. The most promising non-invasive technique to measure the temperature relies on ratiometric luminescent thermometers where the absolute temperature is optically determined via the measurements of the intensities of two transitions of distinct emitting centers. In the case of mixed Ln-MOFs, the temperature is determined from the comparison of the intensity of both Ln$^{3+}$ emissions, generally the transitions $^5$D$_4$-$^7$F$_5$ of the Tb$^{3+}$ and $^5$D$_4$-$^7$F$_2$ of the Eu$^{3+}$, respectively.

In this work, we designed a series of mixed Eu-Tb MOF with isophthalic acid as principal ligand. We studied the impact of modifications in Ln$^{3+}$ coordination sphere on the thermometric performances. Indeed, mixed Eu-Tb MOF synthetized with isophthalic acid is a 2D structure and exhibit performance in the cryogenic range but mixed Eu-Tb MOF synthetized with isophthalic acid and acetic acid is a 3D structure where the Ln$^{3+}$ coordination increases from 7 to 9. This latter MOF is sensible in the physiological range (Fig1).

Figure 1 (Left) Crystal structure and emission spectra of the thermometer in the 12-230 K range of the mixed Eu-Tb MOF with isophthalic acid. (Right) Crystal structure and emission spectra of the thermometer in the 150-330 K range of the mixed Eu-Tb MOF with isophthalic acid and acetic acid.