

Adsorption of  $Gd^{3+}$  ions over a carboxylic- and amino-group dual-functionalized UiO-66 metal-organic framework

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Due to growing demand for rare earth elements (REEs) worldwide, recovering the elements from waste sources needs to be considered, which can also serve reducing pollution caused by REEs in water. In this work, adsorption of  $Gd^{3+}$  in an aqueous solution over a functionalized metal-organic framework (MOF), UiO-66, was investigated. It was initially prepared using a suitable mixture of terephthalic acid and trimellitic acid, which produced coordination free -COOH groups on the MOF structure. The -COOH group was then further reacted with ethylenediamine to introduce additional -NH<sub>2</sub> groups on the MOF. The functionalized product showed an equilibrium adsorption capacity of 76.4 mg/g  $Gd^{3+}$  compared with 16.2 mg/g by the pristine UiO-66. This improvement in adsorption is a consequence of coordination of  $Gd^{3+}$  ions with the -COOH and -NH<sub>2</sub> groups. A solution pH between 6.0 and 7.0 was found to be the best conditions for  $Gd^{3+}$  capture, and high selectivity of 75% towards  $Gd^{3+}$  was observed against the other competing alkali or transition metal ions co-present in the solution. The material was reusable at least 5 cycles without any significant deterioration in the adsorption capacity.