

## **Metal-organic frameworks (MOFs) for separation and recovery of key rare earth elements (REEs) from residual waste materials**

Rare earth elements (REEs) play a key role in current clean energy systems, such as electric vehicles and wind turbine technologies. The growth of these industries in the future will result in a substantial increase in the demand for REEs. However, REEs natural resources are limited, REEs mining is difficult, and the traditional mining industry pollutes the environment. A study by DTU sustain showed that end-of-life, residual wastes, sediments, and contaminated soil in the urban environment are rich in REEs and are potential resources of REEs. Recycling REE from residual waste materials can achieve a circular economy, remediate the polluted environment, and make these 'green' technology sustainable. This project focuses on one of the most important aspects of green energy and circular economy: REEs recycling from residual waste materials.

Among the available REEs separation and recovery methods, adsorption has attracted much attention due to its simplicity, low operating cost, high adsorption efficiency, and potential desorption and reusability. Among recent sorbent materials, metal-organic frameworks (MOFs) have great potential for separating REEs. MOFs are a group of new functional porous materials. MOFs offer tunable microporosity and the possibility to tailor their channels with the appropriate functionalities to improve affinity for target elements, even in a selective manner. Recently, MOFs have shown great potential in gas separation, molecular separation, ion trapping, and water purification. However, rare research on REEs separation using MOFs has been carried out. It is, therefore, necessary to investigate its feasibility and performance.

The project aims to develop a new method to separate and recover key REEs in clean energy systems from residual waste materials using MOFs. First, several water-stable MOFs, with different pore size and structures, modified with different functional groups, will be used to separate individual REEs selectively. Five REEs, considered to be critical for clean energy applications with high supply risk, were chosen: cerium (Ce), neodymium (Nd), dysprosium (Dy), europium (Eu), and yttrium (Y). The main hypothesis of this project is that there is a relation between pore size, structure, and functional group of MOFs and their selectivity of REE ions.