Insights into the Ru substitution on redox activity of HKUST-1 in oxidative desulfurization reaction of a model fuel

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In spite of considerable progress in a relatively short period of time, the development of metal-organic frameworks (MOFs) as heterogeneous catalysts for oxidation reactions has been less explored [1, 2]. Catalytic oxidative desulfurization (ODS) process in liquid fuels is considered as one of the most promising non-hydrodesulfurization technologies, due to the advantages such as mild reaction conditions, low cost, environment-friendly and easy removal of aromatic sulfur compounds [3]. Within the broad class of catalytic materials, much attention has been paid to MOFs as catalysts because they offer varied crystal structures, permanent porosity, high surface area and abundant metal centers [4]. Catalytic applications of MOFs are mainly governed by the nature of metal sites of MOFs. However, in a large number of reports catalytic activity has been limited to the lewis acidity around the metal sites and development of MOFs containing noble metals in which the nodes act as catalytic sites has been less studied, so far [5].

In this work for the first time, the effect of replacement of Cu by Ru on the ODS activity of HKUST-1 has been investigated. It was found that Ru-HKUST-1 exhibits higher catalytic performance even in the presence of very few amounts of H_2O_2 for ODS reaction. We attributed this to the presence of redox-active, coordinatively unsaturated ruthenium sites in the structure of the MOF. Experimental results revealed a ~ 21% improvement in the catalytic activity of Ru-HKUST-1 in the removal of 3 major sulfur compounds from a model fuel when compared to HKUST-1.

References

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