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Non thermal plasma with metal-organic frameworks (MOFs) for challenging catalytic processes

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The limited thermal and hydrothermal stability of metal-organic frameworks (MOFs) often restricts their applications in conventional catalysis involving thermal treatment and/or use of water. Non-thermal plasma (NTP) is a promising technique that can overcome barriers in conventional catalysis.

Here we report an integrated NTP-MOFs processes, which can not only overcome limitations of MOFs for its application in catalytic processes, but also provide energy-efficient alternative to the conventional high-energy consumption and high-carbon emission thermal catalytic process. For example, the NTP-activated water-gas shift reaction (WGSR) over a MOF (HKUST-1). Significantly, the exceptional stability of HKUST-1 has been sustained under NTP activation and in the presence of water, leading to a high turnover frequency (TOF) value of 8.8 h^{-1}.

In addition, we report the first example of NTP-activated direct decomposition of NO_2 over MOF-based catalysts at room temperature and without the use of NH_3 or other reducing agents. At 25 °C and 1.0 bar, 7 wt% Cu-embedded MFM-300(Al) has enabled a near-quantitative conversion of NO_2 (500 ppm diluted in He) into N_2, NO, N_2O with selectivities of 82%, 11% and 7%, respectively. Cu/MFM-300(Al) also shows excellent catalytic stability and an exceptional TOF value of 2.9 h^{-1}, which is comparable to leading NH_3-SCR catalysts using NH_3 at 250-550 °C.

References
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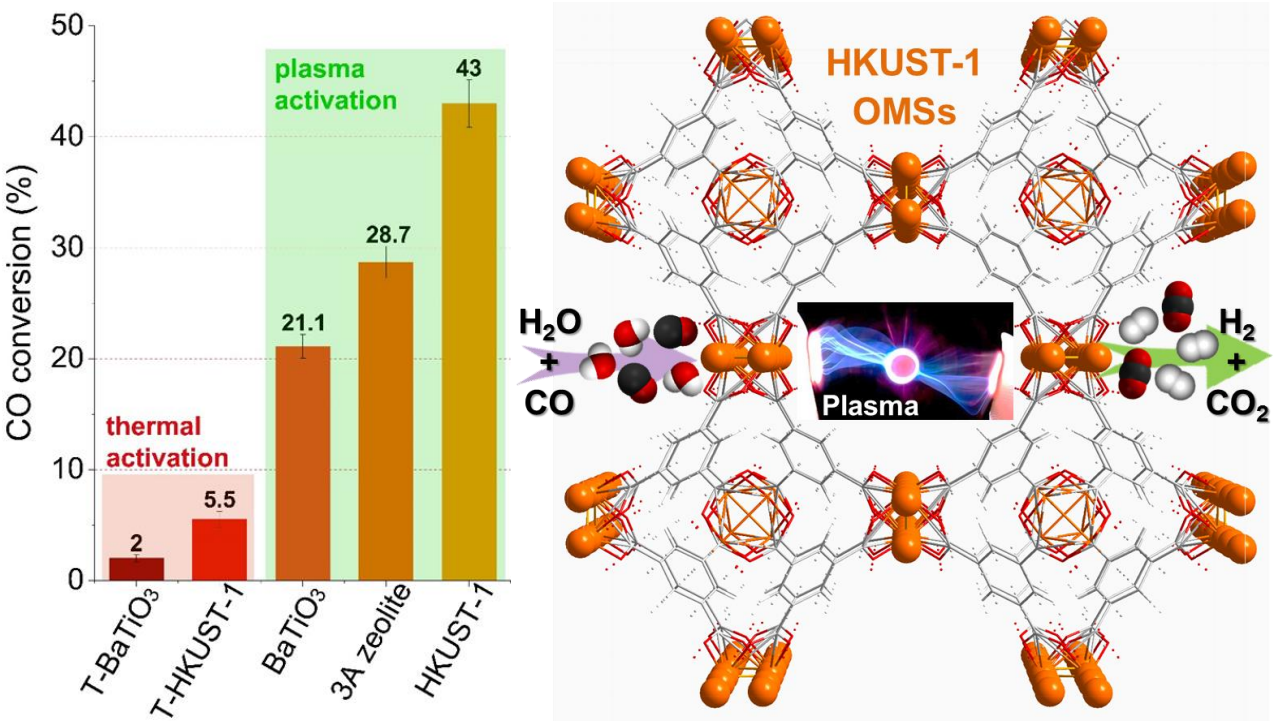

Fig. 1. Catalytic water-gas shift reaction (WGSR) by thermal and NTP activation