

BENEMÉRITA UNIVERSIDAD AUTÓNOMA DE PUEBLA



INSTITUTO DE FÍSICA “Luis Rivera Terrazas”



SEMINARIO “DR. JESUS REYES CORONA”

“Capture of H₂S and SO₂ in MOFs”

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Hydrogen sulphide (H₂S) is a harmful chemical present in natural gas, biogas and emitted by different chemical industries, e.g., oil desulfurization process at oil refineries.¹ H₂S is considered as a major air pollutant due to its negative environmental impact, mainly associated with acid rain,² and to high toxicity to humans leading to severe nervous system illnesses.³

On the other hand, sulphur dioxide (SO₂) considered as one of the most hazardous chemicals is a colourless, non-flammable gas with a strong odour.⁴ SO₂ provokes severe health issues including alterations of the respiratory system (e.g., broncho-constriction in lung function).³ Typically, an exposure to only 1.5 ppm of SO₂ for a few minutes can cause a temporary incapability to breath normally. Moreover, this chemical is highly soluble in water and forms sulphurous acid further converted to sulfuric acid, the main component of acid rain which can damage plants, accelerate the corrosion of metals and attack limestone, marble, mortar, etc.^{1,2} The harmful impact of this pollutant present in atmosphere is also catastrophic in terms of global warming, ozone depletion and climate change.⁴⁻⁶

Metal-Organic Frameworks (MOF) have been envisaged for the capture of H₂S and SO₂ however, some of them, with the main disadvantage of showing poor chemical stability. Thus, in this talk we present two MOF materials highly chemically-stable to H₂S and SO₂: MIL-53(Al)-TDC7 and MFM-300(Sc),⁸ respectively.

MIL-53(Al)-TDC is demonstrated to exhibit one of the highest H₂S capture (18.5 mmol g⁻¹ at 298 K and 1 bar) ever reported for a MOF, to the best of our knowledge, along with the retention of its crystalline structure after multiple H₂S adsorption/desorption cycles and an excellent regeneration at relatively low temperature. MFM-300(Sc) is demonstrated to exhibit a SO₂ uptake of 9.4 mmol g⁻¹ at 298 K and 1 bar significantly higher compared to its Al- and In-analogues, along with the retention of this level of performance after multiple SO₂ adsorption/desorption cycles owing to the high stability of its crystalline structure. Advanced experimental and computational tools have been further coupled to gain insight into the molecular mechanisms responsible for the adsorption of H₂S and SO₂.

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Webinario transmitido en la plataforma Google Meet
Viernes 5 de marzo de 2021
13:00 Hrs.