Advanced concepts for adsorptive based gas/vapor separations/purification with different degree of complexity. Air Capture as a case study

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Summary:

The separation of molecules with close physical properties is a challenging task, commonly performed using the conventional low temperature fractional distillation technique, which is recognized to be highly energy intensive. For more than 6 decades, the revolutionary use of zeolites in general and zeolite molecular sieves in particular led to their deployment in many sectors including adsorptive applications and separation of physically similar molecules within 1 Å difference in size. Accordingly, researchers from both academia and industry have been dedicating a lot of effort to push the limit of structural tunability of zeolites and other families of materials in order to innovate in sieving separation. The main objective of this endeavour is to switch the splitting of important isomers and commodities from distillation or reactive processes to more energy efficient adsorption or membranes technologies.

In the last 2 decades, major developments in advanced materials was dedicated mainly to high surface area materials with large pores rather than molecular sieves with rigid or flexible small pores apertures. In my talk, I will illustrate the progress made in the development of tunable hybrid (inorganic-organic) platforms, with a variety of interesting intrinsic properties, to target challenging adsorptive applications and separation of important commodities in gas/petroleum and petrochemical industries. The optimal structural control at the molecular level of these particular platforms led to the discovery of new advanced adsorbents and molecular sieves, to address challenging separations with different degree of complexity, such as air capture, linear paraffin/mono-branched paraffin, mono-branched paraffin/di-branched paraffin and olefin/paraffin.