

Sieving mechanism within chemically tuned 2D nanochannels for membrane desalination

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Membrane separation technology plays an important role in various fields including water treatment, chemicals and gas separation in many industrial processes, and food processing. There has been a renewed focus on 2D material for membrane application since their atomic thickness and confined interlayer spacing could theoretically lead to enhanced separation performance¹. Indeed, multilayer assembly of single nanosheets creates 2D capillaries that can efficiently sieve chemical species depending on their size. Selectivity- and size controlled diffusion of these nanochannels can be modified to tune the transport mechanism within the structure.

In fact, graphene-based membranes are promising candidates as nanolamellar structures for molecular sieving but their instability in aqueous media alters their sieving performance². Exfoliated nanosheets of transition metal dichalcogenides (TMDs) constitute attractive platforms as nanolaminate membranes. Recent works carried out on nanolaminate membrane made of molybdenum disulfide (MoS_2)³ have demonstrated improved stability⁴. In addition, chemical modifications of the surface of the nanosheets *via* functionalization⁵ have opened new avenues for tuning the membrane properties in both fields of molecular³ and gas sieving. Yet the influence of functionalization of nanolaminate membranes on the sieving performance remains unclear. In order to assess the role of the surface chemistry of the nanosheets on the membrane performance, we developed strategies to covalently functionalize MoS_2 nanosheets⁵. Here we will present our recent investigations on the performance of lamellar membranes based on chemically functionalized MoS_2 nanosheets towards water desalination and micropollutant decontamination. Our results open novel directions for fine tuning the sieving behavior of membranes based on 2D materials.

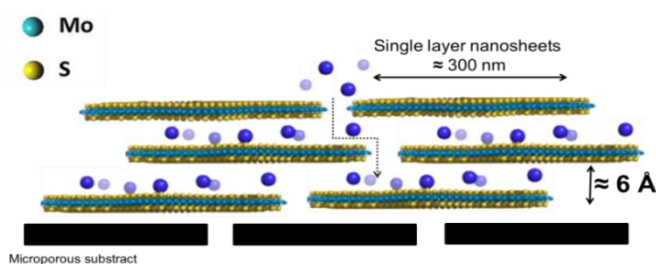


Figure 1. Schematic representation of the diffusion mechanism along continuous 2D capillaries formed within MoS_2 -based nanolaminate membranes [Ir]

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