

# 2D materials based antifouling membranes for ultrafiltration

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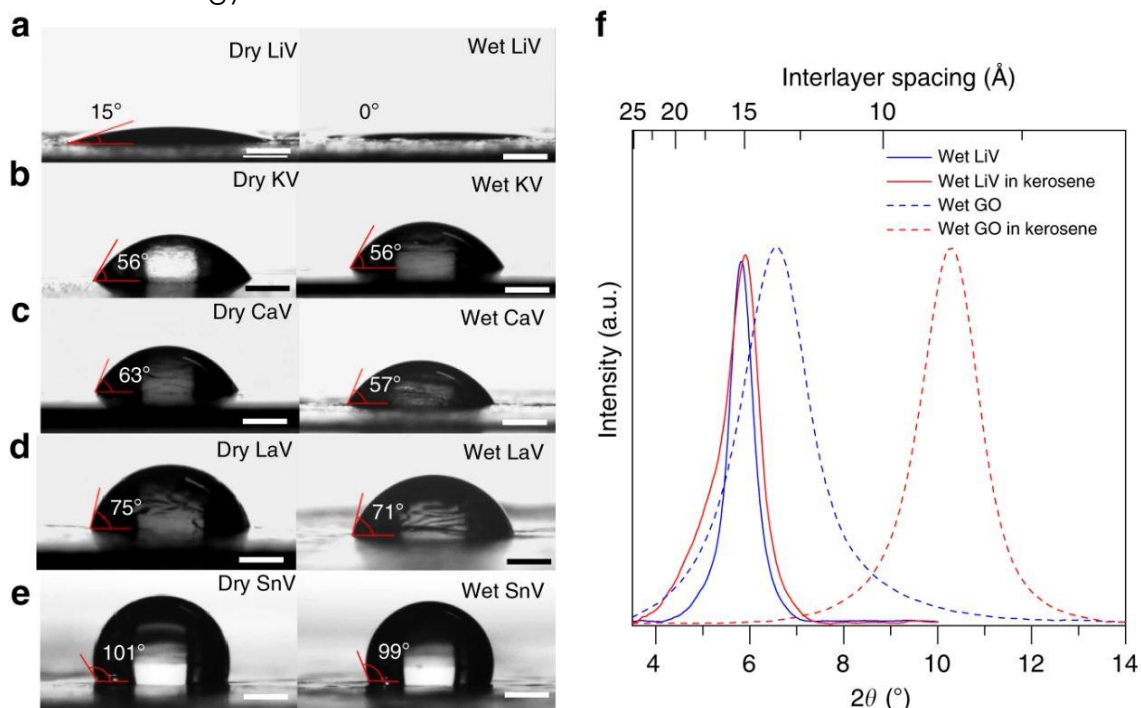
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## Abstract

Inherently hydrophilic surfaces exhibit supreme ability to bind water molecules via hydrogen bonding and provide a steric repulsive barrier to adsorption of organic and protein contaminants<sup>1</sup>. These surfaces offers formidable solutions to improve fouling resistance, hence actively pursued in the case of ultrafiltration membranes. Improved wetting is typically achieved by either chemical modification or by controlling the hierarchical structures of surfaces to manipulate the surface energy<sup>2</sup>. Here we report a paradigm shift approach where the wetting properties of vermiculite laminates are controlled by the hydrated cations on the surface and in the interlamellar space. A superior wetting transition from superhydrophilic to hydrophobic is demonstrated simply by exchanging the cations. The hydrophilicity is observed to decrease with cation hydration free-energy for common cations, whilst the lithium-exchanged vermiculite laminate is found to be a mere exception with its anomalous hydrated structure at the vermiculite surface leading to a superhydrophilic surface. By exploiting this unprecedented wetting control, superior microfiltration membranes are engineered via coating a thin layer of superhydrophilic lithium exchanged vermiculite on polymeric microfiltration membranes to demonstrate their excellent fouling resistant operation, and thus, we address one of the major challenges in membrane-based separation technology.



**Figure 1:** Wetting properties of vermiculite laminates: (a–e) Water contact angle of lithium vermiculite (LiV), potassium vermiculite (KV), calcium vermiculite (CaV), lanthanum vermiculite (LaV), and tin vermiculite (SnV) -laminates in dry and wet states. Scale bar, 750  $\mu\text{m}$  f) XRD from wet LiV laminate before and after immersing in kerosene for a week along with XRD spectra of a reference GO membrane tested at identical condition.

## References

- [1] Ostuni *et al.*, Langmuir 17 (2001) 5605
- [2] Koopal, L. K. Adv. Colloid Interface Sci. 179-182, (2012) 29