Interfacial Molecular Engineering for Functional Polymeric Materials

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Material at the interface is always different from that in the bulk, especially at the molecular scale. In our group, we leverage this unique interfacial molecular behavior to develop/synthesize new functional polymeric materials with unprecedented characteristics. One of the most important platforms in our study is the electrode interface, where a specific molecule-electrode interaction, combined with an electric field, plays a vital role in molecular arrangement and reactions on its surface. We specifically designed such interaction to realize E-field/photo dual-responsive columnar liquid crystals,[1] E-field responsive cholesteric displays,[2] E-field responsive self-assembled monolayers,[3] luffa-like robust/porous nanomembranes,[4] and monolayer polymers.[5] The other key platform is hydrogen bonding, which governs the interfaces among various molecules for assembly and function. This led to the realization of supramolecular polymers exhibiting photo-suspendable chain growth,[6] fluorous nanochannel for highly efficient desalination,[7] and amide-embedded π-systems for selective optical tuning.[8] We aim to synthesize unique functional polymeric materials that fully leverage the specific functions of molecules by enabling their 1D and/or 2D assembly via hydrogen bonding and/or at the electrode interface in a bottom-up manner. In the presentation, I would like to focus mainly on our recent findings of the synthesis of membranes under unconventional electrochemical conditions.

Reference

[1] *Science* **2019**, *363*, 161; *J. Am. Chem. Soc.* **2019**, *141*, 10033; *Chem. Asian. J.* **2022**, e202200223; *Chem. Sci.* **2024**, *15*, 4068–4074.
[2] *Adv.* Mater. **2016**, *28*, 4077; *J. Am. Chem. Soc.* **2018**, *140*, 10946.
[3] *Science* **2015**, *348*, 555; *Chem. Asian. J.* **2020**, *15*, 3321.
[4] *Science* **2025**, *389*, 73.
[5] *J. Am. Chem. Soc.* **2026**, *in press* (*ChemRxiv.* **2026**, doi.org/10.26434/chemrxiv.15000051/v2)
[6] *Nature Commun.* **2017**, *8*, 346; *J. Am. Chem. Soc.* **2021**, *143*, 5121; *J. Am. Chem. Soc.* **2022**, 144, 7080.
[7] *Science* **2022**, *376*, 738.
[8] *ChemRxiv.* **2025**, 10.26434/chemrxiv-2025-cxfzs