

Research Highlights

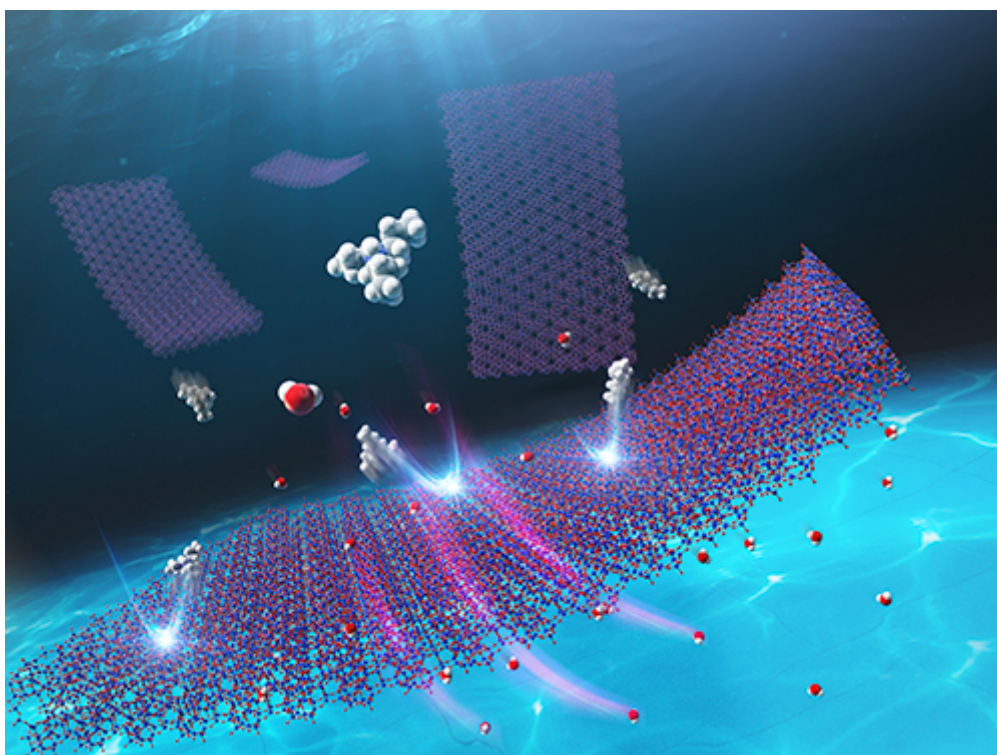
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Exfoliation of Zeolites into Solution Produces Porous Monolayers

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A pioneering study at WPI-MANA has resulted in the first direct exfoliation of zeolites into a liquid suspension of monolayers. This breakthrough provides proof of the presence of monolayers, and could lead to their use in the creation of catalysts, nanodevices, drug delivery systems and other products with tailored properties.



Some two-dimensional (2D) materials, such as graphene, exhibit a variety of unique properties thanks to their molecular thinness and large size, as well as their 2D anisotropy. Catalysts and electrode materials that take advantage of nanosheets' high surface area are a promising field, but the 2D anisotropy prevents efficient transfer of ions and molecules within the materials. Therefore, 2D materials with through-holes are attracting attention, but so far there have been few examples of them.

Zeolites are typical porous materials and some of them have a layered structure. So exfoliating them in a single 2D layer could result in nanosheets with a regular pore structure. Although there have been reports of the synthesis of zeolite nanosheets in trace yields, large quantities of the substance have not been obtained at a usable level.

A WPI-MANA group succeeded in synthesizing zeolite nanosheets (MWW and FER types) by exfoliating them into a single layer by greatly swelling the layered zeolite in a solution containing organic ammonium ions.

Dispersing the zeolites into liquids provides the most effective approach to their practical exploitation to fabricate materials with particular activity and functionality. The suspended layers can be deposited on supports or restacked into hierarchical structures alone or in combination with other 2D materials to produce solids with useful properties.

The exfoliation and proof of the presence of monolayers in the colloids open new possibilities of synthesizing functional hybrid and hierarchically structured materials. The researchers also made predictions about potential applications of zeolite monolayer colloids based on the anisotropic physical properties of 2D materials.

This research was conducted by [Takayoshi Sasaki](#) (MANA Principal Investigator, Group Leader, Soft Chemistry Group, WPI-MANA, NIMS) and his collaborators.

References

“Exfoliated Ferrierite-Related Unilamellar Nanosheets in Solution and Their Use for Preparation of Mixed Zeolite Hierarchical Structures”

Wieslaw J. Roth, [Takayoshi Sasaki](#) et al.

Journal: Journal of the American Chemical Society 143, 29, 11052-11062 (15 July 2021)

DOI : [10.1021/jacs.1c04081](https://doi.org/10.1021/jacs.1c04081)

“Liquid dispersions of zeolite monolayers with high catalytic activity prepared by soft-chemical exfoliation”

Wieslaw J. Roth, [Takayoshi Sasaki](#) et al.

Journal: Science Advances 6 (12), eaay8163 (20 March 2020)

DOI : [10.1126/sciadv.aay8163](https://doi.org/10.1126/sciadv.aay8163)

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