Next generation of reactive ceramic nanofiltration membranes: The Role of Graphene Oxide Nanosheets

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Ensuring universal access to clean, uncontaminated water remains one of the most pressing challenges of our time. This project presents a cost-effective and scalable strategy to fabricate reactive ceramic membranes that not only reject pollutants but also degrade them, offering a dual-function solution for water purification. While nanofiltration ceramic membranes are typically expensive due to the need for multilayer deposition techniques and high-temperature sintering, we demonstrate a simplified process based on a green synthesis of graphene oxide (GO) and direct coating onto porous a-Al_2O_3 ceramic substrates (600 nm pore size). This one-step deposition method reduces processing complexity and eliminates the need for intermediate barrier or selective polymer layers. The GO layer reduces the effective pore size to below 2 nm, enabling true nanofiltration-range rejection. Thin films (~50 nm) are conformally coated onto cylindrical ceramic supports, and their structural integrity is confirmed by SEM and Raman spectroscopy. Water permeance values of ~7 LMH/bar are achieved, and notably, the membranes maintain excellent mechanical integrity under cross-flow filtration at 9 bar with no evidence of delamination. Compared to conventional ceramic NF membranes, this approach significantly lowers production cost and material usage while preserving performance and durability. Our results position GO-coated ceramics as a competitive, economically viable platform for advanced water purification technologies.

References

[1] (1) Cho, Young Hoon, et al. "Sacrificial Graphene Oxide Interlayer for Highly Permeable Ceramic Thin Film Composite Membranes." Journal of Membrane Science, vol. 618, 2021, p. 118442. Elsevier, https://doi.org/10.1016/j.memsci.2020.118442.

Figures

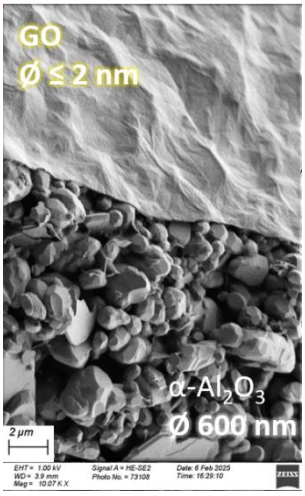

Figure 1: SEM cross section after vertical deposition of GO nanosheets on a-Al_2O_3 ceramic tube