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Novel chemical reactions enable scalable and atom-economic synthesis of two-dimensional metal carbides and nitrides (MXenes). These directly synthesized MXenes show excellent energy storage capacity for Li-ion intercalation.

The direct synthesis route can be used for chemical vapor deposition (CVD) of MXene carpets. The individual 2D sheets in the carpet are oriented perpendicular to the substrate surface, which is ideal for supercapacitor and battery applications.

We also observed a novel regime of CVD growth that conceptually resembles dynamics of cellular membranes during endocytosis: flat MXene carpets evolved into spherical “vesicles” composed of individual  $Ti_2CCl_2$  sheets radiating from the center and oriented normal to the surface. The appearance of the MXene vesicles resembles alien Tribbles from the Star Trek movie “The trouble with Tribbles”

D. Wang, C. Zhou, A. S. Filatov, W. Cho, F. Lagunas, M. Wang, S. Vaikuntanathan, C. Liu, R. F. Klie, D. V. Talapin. Direct synthesis and chemical vapor deposition of 2D carbide and nitride MXenes. *Science* 2023, 379, 1242-1247. DOI: 10.1126/science.add9204

