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Electron-transparent free-standing ultrathin membranes for studying gas-solid and liquid-solid interfaces at high pressures

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The chemical reactions of heterogenously catalyzed processes take place at the gas-solid and liquid-solid interfaces. Thus, significant efforts have been dedicated to developing new methods to study them under realistic conditions. In recent years, electron-transparent graphene windows have been used in ambient pressure X-ray photoelectron spectroscopy (AP-XPS) to separate liquids and gases at ambient pressure from a high vacuum. Following this design, we present free-standing ultrathin (up to 10 nm) Al_2O_3 membranes fabricated by atomic layer deposition (ALD) which are electron-transparent to tender and hard X-rays. Three different commercial supports are used: TEM SiN perforated membranes (1 µm), single-hole stainless steal apertures (20 µm), and TEM Cu-grids (80 µm). Their conformity has been examined by scanning electron microscopy (SEM) and atomic force microscopy (AFM), whereas their chemical composition and homogeneity by energy dispersive X-ray (EDX) mapping. Additionally, confocal µ-Raman microscopy complements the chemical and structural characterization. Conventional free-standing graphene membranes have also been fabricated for comparison purposes.

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