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Regimes of gas transport through macroscopic areas of multilayer graphene[1] MICHAEL BOUTILIER, ROHIT KARNIK, CHENGZHEN SUN[2], NICOLAS HADJICONSTANTINOU, MIT — Nanoporous graphene membranes have the potential to surpass the permeance and selectivity limits of current gas separation membranes. Recent experiments and simulations on individual graphene nanopores have demonstrated that molecule-size-selective nanopores can be created and used to separate components of a gas mixture. However, micrometer-scale tears and nanometer-scale intrinsic defects, inherently present in macroscopic areas of graphene, can severely limit the gas separation performance of graphene membranes of practical size. In this study, we measure the inherent permeance of macroscopic, multi-layer graphene membranes to various gases. A model for the transport of gases through these membranes is developed and shown to accurately explain the measured flow rates. The results quantify the separate contributions of tears and intrinsic defects to the inherent permeance of macroscopic areas of multilayer graphene. The model is then extended to graphene membranes with engineered selective nanopores to optimize design parameters for defect-tolerant gas separation membranes.

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