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Formation of Pore-Spanning Lipid Membrane and Cross-Membrane Water and Ion Transport

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ABSTRACT:

Supported lipid bilayers have the potential to deliver a breakthrough in separation processes, e.g., in desalination. Yet, formation of macroscopically large lipid membranes for use in separations and understanding of their long-term mechanical stability, especially, when they host membrane proteins, is still a challenge. Arrays of microscopic pore-spanning lipid membranes are a promising upscalable configuration, in which lipid membranes do not contact support directly, making it attractive for studying their function and stability. Here we report on (1) the formation mechanism of an array of pore-spanning phospholipid membranes via 'vesicle fusion', and (2) a microfluidic device that is used to assess the stability of the pore-spanning lipid membrane under flow and osmotic gradient. It is shown that the formation of pore-spanning lipid membranes via 'vesicles fusion' proceeds in three steps: First, small vesicles merge into giant ones of about the size of the substrate pore size. The giant vesicles then settle at the pore mouths and flatten. Last, the flattened giant vesicles rupture and form a lipid membrane that closes the pore. Exposing the