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Drop impacts on electrospun nanofiber membranes[1] RAKESH P. SAHU, SUMAN SINHA-RAY, ALEXANDER YARIN, University of Illinois at Chicago, BEHNAM POURDEYHIMI, North Carolina State University — This work reports a study of drop impacts of polar and non-polar liquids onto electrospun nanofiber membranes (of 8–10 mm thickness and pore sizes of 3–6 nm) with an increasing degree of hydrophobicity. The nanofibers used were electrospun from polyacrylonitrile (PAN), nylon 6/6, polycaprolactone (PCL) and Teflon. It was found that for any liquid/fiber pair there exists a threshold impact velocity (1.5 to 3 m/s) above which water penetrates membranes irrespective of their wettability. The low surface tension liquid left the rear side of sufficiently thin membranes as a millipede-like system of tiny jets protruding through a number of pores. For such a high surface tension liquid as water, jets immediately merged into a single bigger jet, which formed secondary drops due to capillary instability. An especially non-trivial result is that superhydrophobicity of the porous nano-textured Teflon skeleton with the interconnected pores is incapable of preventing water penetration due to drop impact, even at relatively low impact velocities close to 3.46 m/s. A theoretical estimate of the critical membrane thickness sufficient for complete viscous dissipation of the kinetic energy of penetrating liquid corroborates with the experimental data.

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