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Carbon Nanotube Micro-Needles for Rapid Transdermal Drug Delivery[1] BRADLEY LYON, ADRIANUS INDRAT ARIA, California Institute of Technology, AMIR GAT, Technion - Israel Institute of Technology, JULIA COSSE, LAUREN MONTEMAYOR, MASOUD BEIZAIE, MORTEZA GHARIB, California Institute of Technology — By catalyst patterning, bundles of vertically-aligned carbon nanotubes (CNT) can be assembled to create 2D arrays of hollow micro-needles with feature size as small as a few microns. For transdermal drug delivery, the most challenging mechanical requirement is to make the CNT micro-needle small enough so that delivery is painless yet large enough so that the micro-needle can achieve skin penetration. By taking advantage of capillary action and the nanoporosity of CNT bundles, we can wick high strength polymer into the inter-spacing between nanotubes to augment the stiffness of our micro-needles. For low viscous polymers, the large ratio between the micron sized center hole of the micro-needle and the nanopores of the surrounding CNT allow us to wick polymer through the nanotubes while maintaining an open central hole for drug transport. For a transdermal patch prototype with a delivery area less than 1cm x 1cm square, we can fabricate 50 CNT micro-needles that produces a total flow rate up to 100 uL/s with actuation pressure provided by a mere finger tap. From in vitro experiments, we will demonstrate that CNT micro-needles provide a much faster convective delivery of drugs than conventional topical diffusion based patches.

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