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Wetting as a basis for a highly selective colorimetric indicator for organic liquids[1] IAN BURGESS, School of Engineering and Applied Sciences, Harvard University, KEVIN RAYMOND, NATALIE KOAY, Wyss Institute for Biologically Inspired Engineering, Harvard University, ANNA SHNEIDMAN, MATHIAS KOLLE, MARKO LONCAR, JOANNA AIZENBERG, School of Engineering and Applied Sciences, Harvard University — We present a colorimetric indicator for organic liquids that couples distinct macroscopic color patterns to minute differences in liquids' intrinsic wettability to a surface. We find that when a liquid percolates through the pores of large-area, defect-free silica inverse-opal films, a highly consistent re-entrant geometry leads to sharply defined threshold wettability for liquid infiltration, occurring at intrinsic contact angles near 20 $^\circ$. The structure also acts as a 3D photonic crystal, producing bright iridescent color that disappears when infiltrated with liquid, coupling the highly selective wetting observed to an easy-to-visualize colorimetric response. Combining a percolation model and FDTD optical simulations, we estimate the selectivity of the colorimetruic response. In addition, we present a technique to generate precisely controlled spatial patterns of surface chemistry throughout the porous network. This lets us tailor the wettability threshold to specific liquids across a continuous range. Using these techniques, we demonstrate the applicability of this indicator to colorimetrically distinguish: i) ethanol-water mixtures varying by only 2.5% in concentration; ii) hexane, heptane, octane, nonane, and decane; and iii) samples of gasoline (regular unleaded) and diesel.

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