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Multifunctionality and Fluid Permeabilities of Triply Periodic Minimal Surfaces YOUNGJEAN JUNG, PRISM and Chemistry, SALVATORE TORQUATO, PRISM, Chemistry, and PACM, Princeton University — It has recently been shown that triply periodic two-phase bicontinuous composites with interfaces that are the Schwartz P and D minimal surfaces are not only geometrically extremal but extremal for simultaneous transport of heat and electricity. The multifunctionality of such two-phase systems has been further established by demonstrating that they are also extremal when a competition is set up between the effective bulk modulus and electrical (or thermal) conductivity of the bicontinuous composite. We computed the fluid permeabilities of these and other triply periodic bicontinuous structures arranged on the sites of a simple cubic lattice at a porosity $\phi = 1/2$ [Y. Jung and S. Torquato, Phys. Rev. E **72**, 056319 (2005)]. We found that the Schwartz P porous medium has the largest fluid permeability among all of the six triply periodic porous media in consideration. The fluid permeabilities are shown to be inversely proportional to the corresponding specific surfaces for these structures. This leads to the conjecture that the maximal fluid permeability for a triply periodic porous medium with a simply connected pore space at a porosity $\phi = 1/2$ is achieved by the structure that globally minimizes the specific surface. We will also present specific single-length-scale, two-dimensional, isotropic multifunctional optimal microstructures at the phase volume fraction $\phi = 1/2$.

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