Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Metamaterials for mass separations JUAN MANUEL RESTREPO-FLREZ, MARTIN MALDOVAN, Georgia Inst of Tech — Metamaterials have recently spread from the field of optics to other areas such as acoustics as well as heat and mass diffusion. In the case of mass transport, the tailoring of metamaterial anisotropy allows to rationally design physical systems in which separation of different and arbitrary compounds can be achieved. The fundamental principle behind these metamaterial devices is the independent manipulation of the diffusion path of the species of interest. In this work, we design the diffusion in metamaterial structures such that different compounds are rerouted along different directions, thus achieving separation via independent control of mass diffusion processes. In particular, we introduce metamaterial-membranes with applications in chemical and biomolecular systems. As a practical example of the capabilities of mass diffusion metamaterials we show how the separation of oxygen and nitrogen can be performed though a polymeric metamaterial. Our results suggest that metamaterial-based membrane separations have higher efficiencies than isotropic and homogeneous membranes. This work opens a new paradigm in the understanding and manipulation of separations by introducing radically new anisotropy-based physical mechanisms for separations.

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Date submitted: 11 Nov 2016 Electronic form version 1.4