Thermal Transport in Nanoengineered Poly-azobenzene Fibers

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Controlling the flow of thermal energy at the nanoscale is of great interest and is realized by creating analog thermal circuit components, like thermal switches, diodes, and rectifiers. The capability of modulating the intrinsic thermal conductivity of relevant nanostructures is key to realizing these applications. In this research, we study the thermal transport of nano/microfibers made of high crystalline, molecular chain-aligned ethylene-glycol azobenzene, aiming to achieve high modulation in thermal conductivity. These fibers undergo conformational changes when exposed to ultraviolet (UV) light, transitioning from a straight-chain (trans) to a bent-chain (cis) conformation. We report our experimental results on using an optics-coupled thermal bridge setup to measure the highly tunable thermal conductivity of poly-azobenzene fibers and its physical dependence on temperature, external optical excitation, and fiber geometry. We also measured the effect of molecular scale factors such as molecular weight, backbone stiffness, and crosslinking on thermal transport using azobenzene as a model organic system. Our studies reveal important insight into the structure-property relationship in molecular-scale thermal transport.