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Terahertz Science and Technology of Macroscopically Aligned Carbon Nanotube Films

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One of the outstanding challenges in nanotechnology is how to assemble individual nano-objects into macroscopic architectures while preserving their extraordinary properties. For example, the one-dimensional character of electrons in individual carbon nanotubes leads to extremely anisotropic transport, optical, and magnetic phenomena, but their macroscopic manifestations have been limited. Here, we describe methods for preparing macroscopic films, sheets, and fibers of highly aligned carbon nanotubes and their applications to basic and applied terahertz studies. Sufficiently thick films act as ideal terahertz polarizers, and appropriately doped films operate as polarization-sensitive, flexible, powerless, and ultra-broadband detectors. Together with recently developed chirality enrichment methods, these developments will ultimately allow us to study dynamic conductivities of interacting one-dimensional electrons in macroscopic single crystals of single-chirality single-wall carbon nanotubes.