Carbon nanomaterials have caught extensive research and application development interests since 1980s. Highlighted by the 1996 Noble prize in Chemistry and the 2010 Noble in Physics, carbon based structures maybe the most studied and mentioned nanomaterials. Many companies are now capable of producing carbon nanomaterials on the order of hundreds tons/per year, but there still exists a tremendous gap of mass application of these materials. With the interest of polymer composite development shifted to nanoscale fillers, material synthesis quality control and throughput becomes important. In our recent study, the vapor-grown carbon nanofibers (VCNFs) and graphene materials were used to instead of the commonly used carbon nanotubes. To improve processing reproducibility, a multi-step dispersion and micro filtration process was developed to assemble the loose CNFs into self-supportive paper sheets form and become a novel platform to achieve multifunctionalities. After incorporating carbon nanomaterials with elastic polymers, significant electro-mechanical coupling effects can be observed. This effect can have extensive application potentials in developing lightweight and high strength composites that can have self-sensing and structure health monitoring capabilities. At the same time, these composites can have improved electromagnetic field shielding and static discharge characteristic together with improved vibration damping and noise reduction functions. Through this example, we expect to demonstrate the great potential of designing non-traditional nanomaterials and developing non-conventional nanomanufacturing techniques.

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