Carbon based nanomaterials such as carbon nanotubes, graphene, and carbon nanofibers have become prominent engineering materials due to unique electrical, thermal, and mechanical properties. These nanomaterials have been engineered as thin films, nanocoatings, and nanostructured surfaces with innovative characteristics and multifunctionalities. They have been applied in a variety of industry sectors such as space, automotive, and aviation providing cost effective solutions and improved performance of products.

In this study, carbon-based nanomaterials are transferred in a form of particles/powders to nanocomposite films through spray deposition processes. The particles are firstly preformed as a film by spraying the suspension of nanoparticles in solvents. Next, the as-prepared film is impregnated with thermoplastic by spraying the solution of polymers. Two different deposition processes (spraying-infiltration and spraying-evaporation) have been explored to produce the film of nanoparticles that allows for continuous production and digital fabrication. A continuous film-making system was developed based on spraying-infiltration process along with air atomization and a continuous drive belt system to produce a continuous roll of the film. The solvent is removed from the nanomaterials through a filtration process. This system is able to continuously produce a film with a width of 6 inches and a thickness of 10 µm at a production rate of 6 inches/min. The as-made film has an electrical resistivity of 113 Ω/square. The major advantage of this process is its ability to mass produce the film. Spray deposition modeling (SDM) is a digital fabrication process based on spraying-evaporation process that uses a 12-array bubble jet nozzle attached to a digital x-y plotter combined with a heated substrate which induces evaporation of the solvent. This process is able to produce a film with variable thickness in defined locations and geometries. The maximum thickness of the film produced with SDM is 10 µm with a resistivity of 95.7 Ω/square.