Abstract for CRADA between NETL and the University of Massachusetts Lowell (AGMT-1275)

The demand for printed electronics over conventional electronics is growing each year due to their low costs, low material waste during manufacturing, and compatibility with flexible substrates. The development of inks for printed electronics is a challenge because each printing technology requires different viscosities and curing behaviors to create devices with controlled structures at the micron scale, or smaller. Carbon is a great candidate for fabricating printed electronics devices because it is inexpensive and earth abundant, easily functionalized to impart miscibility with solvent systems, and has electrical properties that can be tuned from insulating to conducting. Despite these advantages, carbons are rarely used for printed electronics because there is a scarcity of inks available for non-contact printing technologies. To address these challenges, the National Energy Technology Laboratory (NETL) will collaborate with the University of Massachusetts Lowell (Participant) through its Printed Electronics Research Collaborative (PERC) to develop engineered carbons and ink formulations optimized specifically for printing radio- and microwave-frequency electronic devices using ink jet, aerosol jet, syringe dispensing, and other additive manufacturing techniques. NETL will process coal, petroleum, and other carbon feedstocks to make engineered carbons with the appropriate composition, microstructure, surface functionalization, and particle morphologies needed to stabilize ink suspensions and impart useful electronic properties to printed devices. The University of Massachusetts Lowell will utilize these engineered carbons to determine which solvent systems and ink additives are needed to achieve the appropriate viscosity, stability, and printability to make useful ink formulations. The University of Massachusetts Lowell will then utilize these inks to manufacture printed resistors and conductors using inkjet, aerosol jet, and syringe dispensing printing methods and will characterize device performance using four-point probe resistivity measurements, contact angle measurements to assess wettability, adhesion evaluation to various substrates, and focused ion beam and scanning electron microscopy for surface and density investigations of printed devices.