Abstract

Polymer thermoelectric (TE) devices are desirable because of their convenient properties for mobile applications and their ability to be produced at low-cost using well-established solution based techniques. Radical polymers are an emerging class of conducting polymers that have been shown to have electrical conductivities on par with π-conjugated polymers and are readily synthesized by reversible addition-fragmentation chain transfer (RAFT). Poly(2,2,6,6-tetramethylpiperidinyloxy methacrylate) (PTMA) is a well-studied radical polymer that has demonstrated moderate TE properties. The relatively high glass transition temperature of PTMA (T_g ~170 °C), however, causes significant fracturing when deposited as the thick films (~40 μm) required for TE devices which significantly limits device performance and lifetime. As such, it is desirable to synthesize a radical polymer with a lower glass transition temperature that could produce continuous films. Specifically, we propose to remove the methyl group on the polymer backbone which promotes steric hindrance and significantly increases the glass transition temperature of the polymer. Here, 2,2,6,6-tetramethylpiperidinyl acrylate (TMP) is synthesized at room temperature, polymerized via free-radical polymerization (PTMP), and then has the pendant groups functionalized to stable radical sites to form poly(2,2,6,6-tetramethylpiperidinyloxy acrylate) (PTA). The success of the synthesis of the monomer (TMP) and polymer (PTMP) can be characterization via ^{1}H nuclear magnetic resonance (NMR) spectroscopy. Finally, we can demonstrate the lower glass transition temperature of PTA via differential scanning calorimetry (DSC) and its effects on the TE performance.