Enhancement of thermoelectric properties in carbon-nanotube yarns by an improved dispersion method

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Recently, thermoelectric (TE) generators have been attracting a great attention of researchers as a promising energy-harvesting technology for wearable and the Internet of Things (IoT) applications. Carbon nanotube (CNT) is one of the most promising candidates of flexible TE materials due to their high electrical conductivity and excellent mechanical properties. Moreover, CNT is suitable for yarn-type configuration due to their high aspect ratio which can realize to achieve a thick device with high TE performance.[1] In our previous study, a dispersion method for CNT yarn using combination of ionic liquid (IL) and surfactant was reported (named method D).[2] However, IL is expensive and harmful to the environment.[3] Therefore, developing the cost-effective and eco-friendly dispersion process of CNT in aqueous media is crucial for the product-grade thermoelectric yarn. In this work, we have developed a new dispersion method (named method F) using glycerol which is not only cheap and non-toxic, but also showing higher viscosity which is effective for dispersion of CNT, substituting for the ionic liquid.

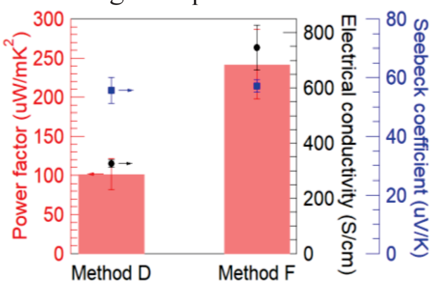

Fig. 1. TE performance of CNT yarns

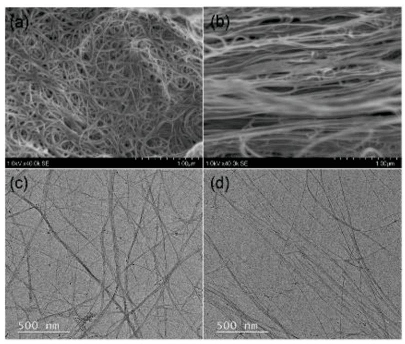

Fig. 2. SEM and TEM images of CNT yarns by method: D (a), (c) and F:(b), (d).

The TE performances of CNT yarns fabricated by two different methods are compared in Fig. 1. The power factor in method F was enhanced around 2.5 times contributed primarily by the enhancement of electrical conductivity. The surface morphology was characterized by SEM to evaluate the origin of the different TE performance, showing a better alignment of CNT in method F (Fig. 2). In addition, method F generated smaller CNT bundle diameter as shown in the magnified TEM images. This could be due to the higher viscosity of glycerol (1 Pa.s) than that of IL/surfactant (0.4 Pa.s) to disentangle CNT bundles, resulting in the better CNT alignment.

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