Mesoporous carbon coated carbon nanofibers for Lithium-air battery.

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Recently, metal-air batteries have attracted much attention because of their considerably higher specific energy density than that of conventional Li-ion batteries [1]. Among metal-air batteries, lithium-air batteries offer the highest theoretical energy density [2]. However, many researchers have faced substantial challenges that they have to overcome the limits of practical energy density for developing high power energy storage systems.
In previous research, the practical discharge capacity is far lower than the theoretical values because the reaction products (Li_2O or Li_2O_2) are difficult to dissolve in the non-aqueous electrolyte and they can block the oxygen path for oxygen diffusion. Due to these reasons, the performance of the Li-air battery strongly depends on the carbon-based cathode [3-5].

In this study, we successfully synthesized the mesoporous carbon coated carbon nanofibers with core-shell configuration (carbon nanofibers@mesoporous carbon) via electrospinning and nanocasting strategy.

Electrospinning was employed to produce core Polyacrylonitrile (PAN)-based carbon nanofibers. The electrospun fibers were thermally treated to obtain carbon nanofibers. In order to make carbon nanofibers@mesoporous carbon coreshell structure, mesoporous silica coating on carbon nanofibers was carried out prior to mesoporous carbon coating. After the mesoporous silica coating, carbon sources infiltrate the silica particles using nanocasting strategy [6]. The obtained mixture was pyrolyzed and carbonized in a nitrogen atmosphere. Finally, hydrofluoric acid was used to etch the silica shells.

Various technique including scanning electron microscopy (SEM), X-ray diffraction (XRD), and transmission electron microscopy (TEM) were employed to characterize micro structure. To figure out the differences of surface area and porosity between pristine cabon nanofibers and carbon nanofibers@mesoporous carbon, the brunauer-Emmett-Teller (BET) surface area was performed. The electrochemical properties of mesoporous carbon@carbon nanofibers as cathode electrode in lithium-air battery were studied using galvanostatic charge-discharge characteristics. As-synthesized carbon nanofibers@mesoporous carbon by electrospinning technique was expected to possess large specific surface area and highly mesoporous structure. Unique structure of carbon nanofibers@mesoporous carbon provides the high specific discharge capacity which makes them promising cathode candidates for high performance non-aqueous lithium air batteries.

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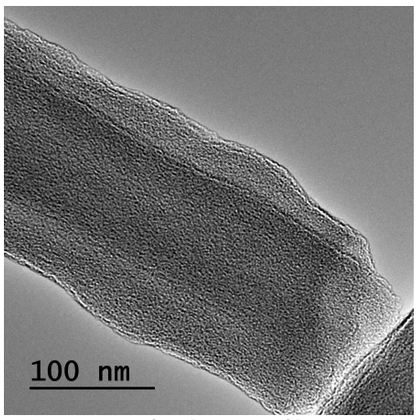

Fig. 1 TEM image of carbon nanofiber@mesoporous carbon

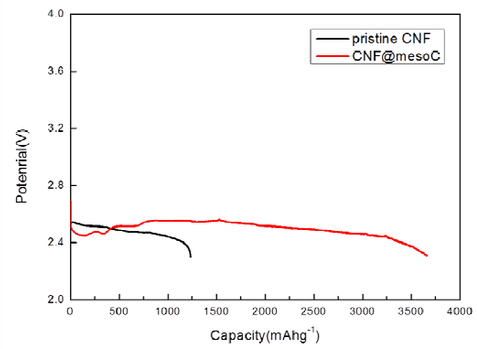

Fig. 2 Discharge curves of pristine carbon nanofibers and carbon nanofiber@mesoporous carbon at constant current density of $0.1mAcm^{-2}$.