Hollow-tunneled graphitic carbon nanofibers as high-performance anode materials

With the support by the National Natural Science Foundationof China (Grant No. 51274240), Prof. Zhou Xiangyang's laboratory at the School of Metallurgy and Environment, Central South University, reported an excellent anode material for lithium ion batteries (LIBs), naming activated N-doped hollow-tunneled graphitic carbon nanofibers (ANHTGCNs), which was published in *Energy & Environmental Science* (**2014**, 7: 2689—2696). And the follow-up work that focused on a three-dimensional graphene architecture was published in *Nano Energy* (**2014**, 8: 62—70). These studies were co-authored with Prof. Zhou Limin's group from the Hong Kong Polytechnic University.

N-doped nanoporous graphitic carbon has attracted great interest because of its distinctive structure and physical properties. In this work, a novel method was proposed to control Ni-induced graphitization by diffusing Ni nanoparticles from graphitic carbon spheres into N-doped amorphous carbon nanofibers, which turns amorphous carbon into graphitic carbon and produces a hollow-tunnel structure in electrospun carbon/Ni nanofibers. The resultant materials were further treated by chemical activation and acid treatment to develop ANHTGCNs. Strikingly, ANHTGCNs are excellent anode materials for lithium ion batteries, displaying a superhigh reversible specific capacity of ~1560 mA h g^{-1} at a current density of 0.1 A g^{-1} with outstanding rate capability and good cycling stability. This controlled Ni-diffusion graphitization synthesis opens up a new path for the fabrication of polymer-based graphitic carbon nanofibers with a favorable nanostructure comprising N-doping, a high surface area, and a porous structure.

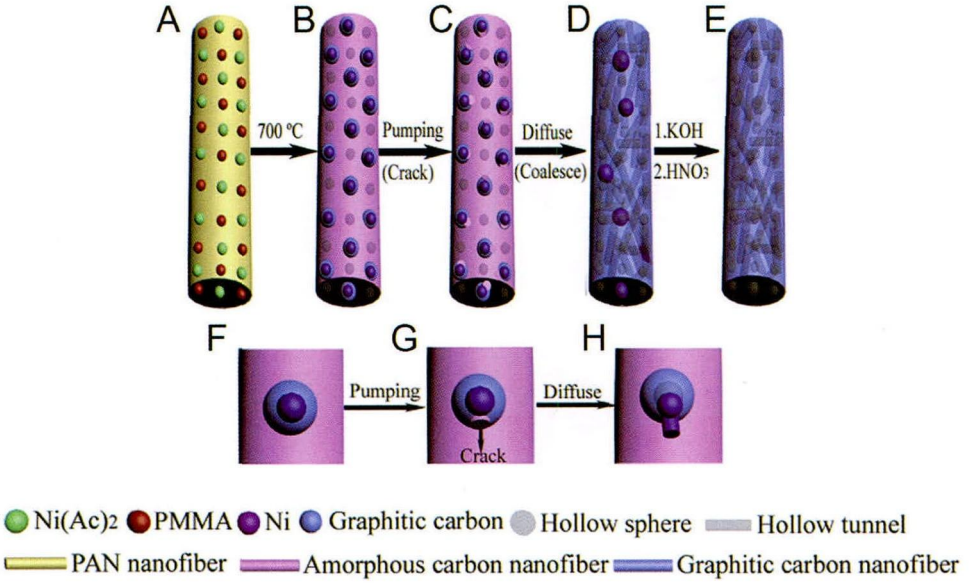

Figure Schematic of material processing. A, PAN/Ni(Ac)$_2$/ PMMA composite nanofiber; B, N-doped hollow-sphere carbon/Ni nanofiber (NHSCNN); C, N-doped hollow-sphere carbon/Ni nanofiber, where the graphitic layers are cracked; D, N-doped hollow-tunneled graphitic carbon/Ni nanofiber (NHTGCNN); E, activated N-doped hollow-tunneled graphitic carbon nanofiber (ANHTGCN); F-H, magnified images of (B—D).