S-5

Synthesis of Ultra-long Hollow Chalcogenide Nanofibers

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Nanoengineered materials with advanced architectures are critical building blocks to modulate conventional material properties or amplify interface behavior for enhanced device performance. While several techniques exist for creating one dimensional heterostructures, electrospinning has emerged as a versatile, scalable, and cost-effective method to synthesize ultra-long nanofibers with controlled diameter (a few nanometres to several micrometres) and composition. In addition, different morphologies (e.g., nano-webs, beaded or smooth cylindrical fibers, and nanoribbons) and structures (e.g., core-.shell, hollow, branched, helical and porous structures) can be readily obtained by controlling different processing parameters. Although various nanofibers including polymers, carbon, ceramics and metals have been synthesized using direct electrospinning or through post-spinning processes, limited works were reported on the compound semiconducting nanofibers because of incompatibility of precursors. In this work, we combined electrospinning and galvanic displacement reaction to demonstrate cost-effective high throughput fabrication of ultra-long hollow semiconducting chalcogen and chalcogenide nanofibers. This procedure exploits electrospinning to fabricate ultra-long sacrificial nanofibers with controlled dimensions, morphology, and crystal structures, providing a large material database to tune electrode potentials, thereby imparting control over the composition and shape of the nanostructures that evolved during galvanic displacement reaction.

Keywords: Electrospinning, Galvanic displacement, Chalcogenide nanofibers

S-6

Application of Oxide Nanofibers Synthesized by Electrospinning to Chemical Sensors

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Nanofibers, one of various one-dimensional nanomaterials such as nanorods, nanowires and nanotubes have been successfully synthesized by many groups in recent years and their applications to chemical sensors, catalytic filters and biomedicine, etc. are extensively tested. In particular, there is a possibility that chemical sensors based on oxide nanofibers can overcome the shortcomings of chemical sensors based on single nanowires. In order to prepare oxide nanofibers, the electrospinning method is most widely used. In this work, we synthesized various oxide nanofibers including ZnO, $SnO2$ and CuO by employing an electrospinning method and various shapes of nanofibers including core-shell nanofibers and hollow nanofibers as well. The response properties of the various nanofibers to oxidizing and reducing gaseous species have been investigated systematically. The normal oxide nanofibers showed high sensitivity and quite fast response time to many gaseous species. Furthermore, derivatives of normal nanofibers including hollow nanofibers, core-shell nanofibers and heterostructured nanofibers display much superior sensing properties. These results hold promise for the practical application of oxide nanofibers to chemical sensors. In addition, the sensing mechanisms operated in the nanofibers will be discussed in detail.

Keywords: Electrospinning, Fiber, Sensor, Nanomaterial