Lithium ion batteries (LIBs) have been used in various applications such as portable electronics, grid storages, and electric vehicles (EVs). Despite its commercial success, further advancement of the battery is necessary to satisfy the increasing demands for low-cost and high-performance energy storage devices as LIB is reaching its theoretical limits. Lithium sulfur battery (LSB) is one of the promising candidates for the next generation energy storage technologies. LSB uses sulfur cathode which is a low-cost and earth abundant material with an extremely high theoretical capacity of 2600 Wh/kg. Although there have been numerous researches aiming to establish the LSB technology, it is still in a development stage. Some of the major challenges are: low-electric conductivity, dissolution of the intermediate lithium-polysulfide reactants, and the low Coulombic efficiency. Use of lithium anodes in LSBs also creates additional challenges by the electrolyte decomposition at the reactive lithium surface and the formation of the dendrites. These issues must be overcome before LSBs can become practical.

The objective of this work is to develop a LSB cathode that solves the above issues and contributes to advancing the development of the LSB technology. We focus on improving the electrical conductivity while reducing the shuttle effect, a parasitic reaction of the polysulfides at the anode lithium surface. To achieve this goal, we developed a carbon black coated free-standing carbon cloth. It is infiltrated with a Li2S8-containing catholyte as an active material, and its carbon framework serves as an entrapment of the polysulfides. The electrode composite enabled high-sulfur-loading, and its high surface area increased the reaction sites allowing the effective utilization of the sulfur that lead to the high capacity. It also showed high capacity retention by successfully trapping the polysulfides within the electrode. This facile and low-cost solution contributes to the realization of the LSBs.

Major: Materials Science and Engineering

Educational Career:
Bachelor's of Materials Science and Engineering, BS, 2016, Zhengzhou University

Committee in Charge:
Akihiro Kushima, Chair, Materials Science & Engineering
Xiaofeng Feng, Physics
Yang Yang, Materials Science & Engineering

Approved for distribution by Akihiro Kushima, Committee Chair, on October 21, 2019.

The public is welcome to attend.