High-Safety Potassium-Sulfur batteries Using Potassium Polysulfide Catholyte and Metal-Free Anode

김희민, 선양국†
한양대학교
(yksun@hanyang.ac.kr†)

Potassium–sulfur (K–S) batteries offer low cost and high specific energy density. Previous work pioneered a K–S battery system operating at room temperature based on the conversion reaction $S_8 \leftrightarrows K_2S_3$. However, no major follow-up work has been reported beyond this, mainly because of the difficulties associated with the high reactivity of the potassium metal anode and the slow reaction kinetics of solid sulfur. we propose a novel K–S cell consisting of a solution phase potassium polysulfide catholyte and a 3-dimensional freestanding carbon nanotube film electrode. (as a reservoir for the polysulfide catholyte). Based on the reversible conversion reactions, K_2S_x ($5 \leq x \leq 6$) $\rightarrow K_2S_3$ (discharge) $\rightarrow$ K_2S_5 (charge), the proposed K–S battery delivered a high discharge capacity with stable cycle retention and good rate capability. In addition, instead of an explosive and highly reactive potassium metal electrode, a full cell consisting of an electrochemically potassium-impregnated hard carbon and the K_2S_x ($5 \leq x \leq 6$) catholyte was constructed to demonstrate the feasibility of a safe K–S battery system free of metallic potassium.