1D fibrous sulfur composite for sodium-sulfur batteries operating at room temperature

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Sodium-sulfur (Na-S) batteries are one type of molten salt batteries and have been used for grid scale storage applications utilizing excellent lifetime and abundance of raw materials for several decades. However, preservation of the molten state and moderate Na diffusion in the solid electrolyte require high-temperature operating conditions typically above 300 °C, limiting their propagation into a wide range of applications. Herein, we demonstrate that Na−S battery with solid state active materials can perform well even at room temperature when sulfur composites generated from a simple thermal reaction were used as sulfur positive electrodes. Furthermore, this structure turned out to be robust during repeated (de)sodiation for ~500 cycles and enabled extraordinarily high rate performance when one-dimensional (1D) fibrous morphology is adopted using scalable electrospinning process. The current study suggests that solid-state Na−S battery with appropriate atomic configurations of sulfur active materials could cover diverse battery applications where cost of raw materials is critical.