Joule

CellPress

Article

Designer Anion Enabling Solid-State Lithium-Sulfur Batteries

Heng Zhang,[1,*] Uxue Oteo,[1] Xabier Judez,[1] Gebrekidan Gebresilassie Eshetu,[2,3] Maria Martinez-Ibañez,[1] Javier Carrasco,[1] Chunmei Li,[1] and Michel Armand[1,4,*]

[1]Electrical Energy Storage Department, CIC Energigune, Parque Tecnológico de Álava, Albert Einstein 48, 01510 Miñano, Álava, Spain

[2]Institute for Power Electronics and Electrical Drives (ISEA), RWTH Aachen University, Jägerstraße 17/19, 52066 Aachen, Germany

[3]Department of Chemistry, College of Natural and Computational Sciences, Mekelle University, P.O. Box 231, Mekelle, Ethiopia

[4]Lead Contact

July 17, 2019

https://doi.org/10.1016/j.joule.2019.05.003

Summary

With an extremely high theoretical energy density, solid-state lithium-sulfur (Li-S) batteries (SSLSBs) are emerging as one of the most feasible chemistries; however, their energy efficiency and long-term cyclability are severely hampered by the lithium metal (Li°) dendrite formation during repeated discharge/charge cycles and the shuttling of aggressive polysulfide intermediates between two electrodes. Herein, we report (difluoromethanesulfonyl) (trifluoromethanesulfonyl)imide anion $[N(SO_2CF_2H)(SO_2CF_3)]^-$, hereafter DFTFSI $^-$, as a designer anion for high-performance polymer-based SSLSBs. In contrast to the widely used bis(trifluoromethanesulfonyl)imide anion $[N(SO_2CF_3)_2]^-$ (TFSI $^-$), DFTFSI-based SSLSBs provide superior interfacial stability against Li°, extremely high discharge and areal capacities, very high Coulombic efficiency, and long-term cyclability, surpassing the reported literature values, in terms of gravimetric energy density. This work opens a new door for accelerating the practical deployment of SSLSBs in the future.

Graphical Abstract