Future Generation Batteries: Solid State Batteries

Gat, Ariel (School: Tamar Ariel (Shapira) School)

Batteries are integral components of our daily life. The commercial batteries comprise a liquid electrolyte, that closes the electric circuit between the positive and negative electrodes. Although widely used, batteries are yet to fulfill their potential, due to the risk for spontaneous flares, a narrow electrochemical window, and the formation of dendrites that short the battery during fast charging, to name a few. These limit the evolution of novel technologies with high energy demands, such as electric cars and robotics. Solid-state batteries, encompassing a solid electrolyte between the two electrodes, were suggested as a potential solution for many of these limitations. However, the realization of this potential was found to be challenging due to the formation of point contacts, instead of a continuous interface, which leads to very high local electrical resistivity which damages the battery. Herein, I developed a solid-state battery with metallic sodium as the anode, sodium-titanium-phosphate (NTP) as a cathode, and a solid electrolyte based on ceramic material and a polymer, beta-alumina and polyethylene oxide, respectively. The characterizations of the system have shown higher stability and capacitance compared to a similar liquid-electrolyte battery, and very low resistivity, compared to other studies. This is attributed to the polymer softening the electrode-electrolyte interface, increasing the contact areas, and increasing the conductivity. The achieved results open the path for the development of the next generation of batteries and for the introduction of emerging technologies that necessitate their advantageous features.

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