EV Battery Chemistries – Alternate to Li-Ion

Though the dominant battery chemistry in Rechargeable Energy Storage System (RESS) in EVs has been based on Li-ion, of late, alternate chemistries without the use of Lithium are being increasingly developed and matured towards cost-effective mass production. Metal-air batteries have become a promising alternate power source to Li-ion based solutions because of their high theoretical energy density and their use of atmosphere oxygen as fuel. Specifically, Aluminium (Al) and Zinc (Zn)-based battery chemistries are intensively being studied. Aluminium (Al) is inexpensive, safe, highly recyclable, and is the third most abundantly available element. Al-air battery has high specific energy and provides storage capacity rivalling that of Li-ion based battery (2.98 Ah/gm for Al-air vs 3.86 Ah/gm). Because of its lower reactivity, easier handling, and greater safety, Al-air battery offers significant cost savings and safety improvements over Li-ion batteries. A major barrier preventing the commercialization of Al-air batteries is the high rate of Al self-corrosion in alkaline solutions under both open-circuit and discharge conditions. Additionally, by-products such as Al_2O_3 and $Al(OH)_3$ accumulate at both the anode and cathode, which not only suppress electrochemical reactions but also render Al-air batteries to be non-rechargeable with Aluminium bound to be replaced after its use. Recent research studies using ionic-liquid based electrolytes have opened the possibility of developing Al-air "rechargeable" batteries. In a recent study, a solid-state, rechargeable aluminium–air battery with stable electrochemical reactions could be achieved with a deep eutectic solvent-based solid electrolyte composed of $AlCl_3$, urea, carboxymethyl cellulose (CMC), and glycerine. This study was the first one to show that by-products have not been observed on either the Al anode or the air cathode that typically suppress electrochemical reactions and reduce the battery life.

Reference: Ryohei Mori, "All solid-state rechargeable Al-Air battery with deep eutectic solvent-based electrolyte and suppression of by-products formation, RSC Advances, 2019, 9, 22220
http://dx.doi.org/10.1039/c9ra04567h

Reference: "Aluminium air battery technology for electric vehicles" https://doi.org/10.1036/1097-8542.BR0106142

Reference: Billy Hurley, "New metal air battery design offers a potential boost to electric vehicles
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