**Abstract:** The chemistry of storage batteries is distinct from that of Li-ion batteries, a typical power battery. The disparity comes from the different market evaluation metrics on these two types of batteries. Li-ion batteries are not suitable for storage due to two primary challenges—the shortage of cobalt and nickel and the safety hazard. Storage batteries will need to be installed at the gigawatt scale to store the renewable electricity from solar and wind. The primary evaluation metric of storage batteries is the levelized energy cost, which is the cost for every kWh delivered from the storage facility. The current batteries in the market, other than Li-ion batteries, cannot meet the demand. The different metrics for storage batteries unleash the opportunities for inventing new battery chemistry that employs new electrochemical reactions. The type of charge carriers represents the centrality regarding the properties of the electrochemical reactions. Our results show that the same electrode behaves differently with different ion charge carriers. Our expedition of ion-storage reactions has gone from Na\(^+\) to K\(^+\), hydronium to proton, NH\(_4\)^+ to large molecular ions, non-redox-active ions to redox-active Cu\(^{2+}\), and from cations to anions. We revealed with examples that it is the interactions between the ion and the chemical environment in the electrode structure that affect the thermodynamic and kinetic properties of the electrode reactions. And such interactions may range from pure ionic to partially covalent. These chemical interactions have implications that are not well understood. I will share with we have learned so far. Among the charge carriers, the least explored are the anions; I will address the vast opportunities in front of the battery research community regarding anion batteries.

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