LITHIUM METAL BATTERIES

Measuring the dead

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Metallic Li is considered as the ultimate anode choice for future high-energy batteries. However, Li plating and stripping during battery charging and discharging, respectively, are imbalanced, leading to formidable challenges including capacity decay and Li dendrite formation. Lying at the heart of these problems is the formation of inactive Li during cycling, consisting of both Li^+ compounds in the solid electrolyte interphase (SEI) and unreacted metallic Li (Li^0); the former is generated from reactions between the anode and the electrolyte, and the latter is caused by the stripping process. Understanding their roles in battery operations is important, but there has been no technique so far to distinguish between the two inactive components. Now, Ying Shirley Meng and colleagues in the USA develop a method based on titration gas chromatography to quantify the contributions of Li^0 and Li^+ to the total inactive Li, and identify Li^0 to be the dominant factor for the capacity decay.

Because Li^0 reacts with H_2O, generating H_2, and Li^+ in the SEI does not, the researchers titrate the inactive Li^0 with H_2O, using gas chromatography to quantify the amount of H_2 produced and therefore the content of Li^0. As the total amount of inactive Li is known from the capacity loss during cycling, the content of Li^+ is also determined. Correlating these quantities with electrochemical measurements and SEI structural characterization, the researchers are able to illustrate the mechanisms that lead to the formation of the inactive Li and find that Li^0 is the main cause for the low battery cyclability. They also identify an ideal interfacial Li architecture for stable Li metal batteries, which requires a columnar microstructure with minimized tortuosity and a homogeneous SEI, and postulate ways to achieve it.

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