Capacitive anion intercalation enables high-power graphite cathodes

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Abstract

Developing high-power cathodes is crucial to construct next-generation quick-charge batteries for electric transportation and grid applications. However, this mainly relies on nano-engineering strategies at the expense of low scalability and high battery cost. Here we provide another option to build high-power cathodes by exploiting inexpensive graphite as the active material, where anion intercalation is involved. With the assistance of a strong alginate binder, ultrahigh power capability up to 42.9 kW/kg at the energy density of >300 Wh/kg (based on graphite mass) and long cycling life over 10000 cycles were achieved, much higher than those of conventional cathode materials for Li-ion batteries. A self-activating and capacitive anion intercalation into graphite was discovered for the first time, making graphite a new intercalation-pseudocapacitance cathode material. Our finding highlights the kinetical difference of anion intercalation (as cathode) from cation intercalation (as anode) into graphitic carbon materials. It is also a timely fundamental answer to address the origin of high power capability of all graphitic carbon cathodes (graphene, graphite) in Al-ion batteries and dual-ion batteries. New high-power energy storage devices will be inspired.

References

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Figures

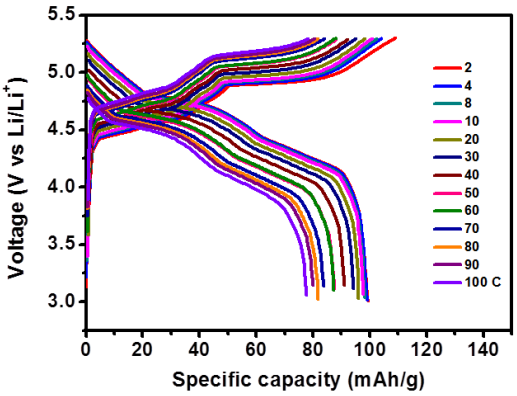

Figure 1: Galvanostatic charge-discharge curves of graphite cathodes at various rates.

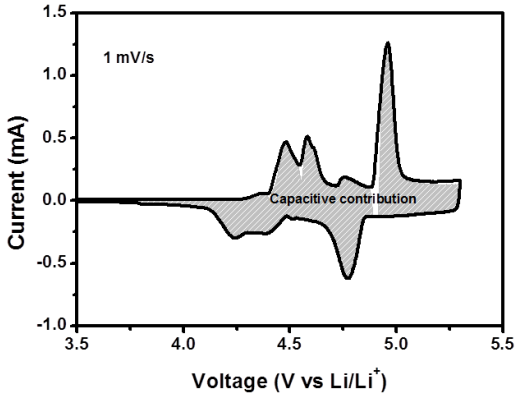

Figure 2: Separation of the capacitive and diffusion currents of graphite cathodes at a scan rate of 1 mV/s.