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Rechargeable Li/O_2 Batteries

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Rechargeable Li/O_2 batteries systems have attracted much attention in the past few years because of its high theoretical energy density compared to traditional lithium ion batteries [1]. However, even though many efforts have been made in this field, the future of this technology is still unclear, becauseit is suffering from poor cycleability, serious side reaction, and large overpotential, which limit its practical use in commercial applications.

Recently a group in Korea reported a carbon based oxygen cathode that is able to operate at high currents with excellent capacity retention [2]. With a tetra (ethylene) glycol dimethyl ether–lithium triflate ($TEGDME–LiCF_3SO_3$) electrolyte, the cell can deliver a discharge capacity of 5000 $mAh{\cdot}g_{carbon}^{-1}$ at a current density of 3 $A{\cdot}g_{carbon}^{-1}$. Although the fundamental behind this discovery is not well understood, the authors claimed that the superior electrochemical performance is due to the high stability of electrolyte during the operation. Interestingly, another group in Scotland reported a similar performance using a nanoporous gold electrode [3]. Using a dimethyl sulfoxide electrolyte, a discharge capacity of ~300 $mAh{\cdot}g_{gold}^{-1}$was achieved, which is equivalent to 3000 $mAh{\cdot}g_{carbon}^{-1}$ when a carbon support is used. Breaking through in advanced battery technologies will impact our everyday life in a significant way. For example, current state-of-the-art fully electric vehicle can drive 100 miles at maximum within a single charge, while in theory rechargeable Li/O_2 battery could extend the driving range to over 300 miles. Although it is still too early to tell whether the Li/O_2 system will lead to a commercial success, such an advanced battery system, at least, shows great potential to enable electric vehicle as a realistic option to replace traditional gasoline vehicles for commuting and social purposes.

References

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