**Introduction**

The emerging portable electronic devices and green electric vehicles (EVs) require a high energy density for the energy-storage system. Among all rechargeable batteries, lithium-ion batteries (LiBs) and beyond are displaying great potential in EVs.

**Features of Al:**
- Limited rate and cycling performance
- Low cost
- High electrical conductivity
- Low potential plateau

The challenge for aluminum is the severe pulverization during charging/discharging that limits the rate and cycling performance.

**Obstacles and Challenges:**

The volume change results in breaking/reforming of the SEI film on top of the active materials.

**Our strategy**

For the first time, a rationally designed yolk-shell configuration that is composed of aluminum nanoparticle as core and an titanium oxide as shell was synthesized.

**Synthesis process**

1. Original Al particles were immersed in the solution.
2. TiO₂ started to cover the surface of the Al particles.
3. Under acidic condition, both the removal of Al₂O₃ and the formation of TiO₂ shell happened at the same time.

**Characterization**

TEM and SEM images of Al@TiO₂ yolk-shell structure.

**Conclusions**

The battery with Al@TiO₂ yolk-shell structure displayed 10 C charge/discharge rate with a reversible capacity exceeding 650 mAh/g after 500 cycles, with a 3 mg/cm² loading. At 1 C, the capacity was ~1200 mAh/g after 500 cycles. The simple method shows great potentials in industrial productions and applications.

The Al particles with size of micrometers are being considered to replace nanoparticles for the Li-Al batteries with a further low cost.

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**Literature cited**


A High-Performance Li-Al Battery For Electric Vehicles

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