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A novel organosilicon-based ionic plastic crystal as solid-state electrolyte for lithium ion batteries

Xin-yue ZHAO

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Main Goal

- Investigate the chemical structure and the physical and electrochemical properties of organosilicon-based ionic plastic crystals (OS ICP).
- Improve the conductivities of OS ICP by doping.
- Improve cycle performance of all solid-state lithium-ion battery using OS ICP electrolyte.

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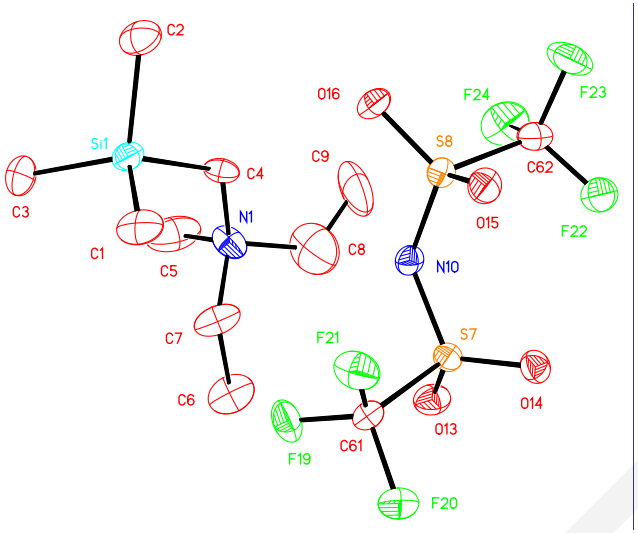
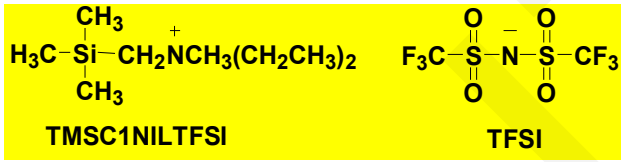
Main Approach and Strategies





- **[DTMA][TFSI] was synthesized with N-[(trimethylsily)methyl]-N,N-diethylamine as raw material through a two-step route.**
- **To improve the conductivity of organosilicon-based ionic plastic crystals by doping lithium salt and Propylene carbonate.**
- **Optimizing the doping content of LiODFB and PC in [DTMA][TFSI].**
- **To investigate the electrochemical performances of the optimized composite as solid electrolyte in LiFePO4/Li half-cells.**

Three Representative Activities

Thermal and Conductivity performance

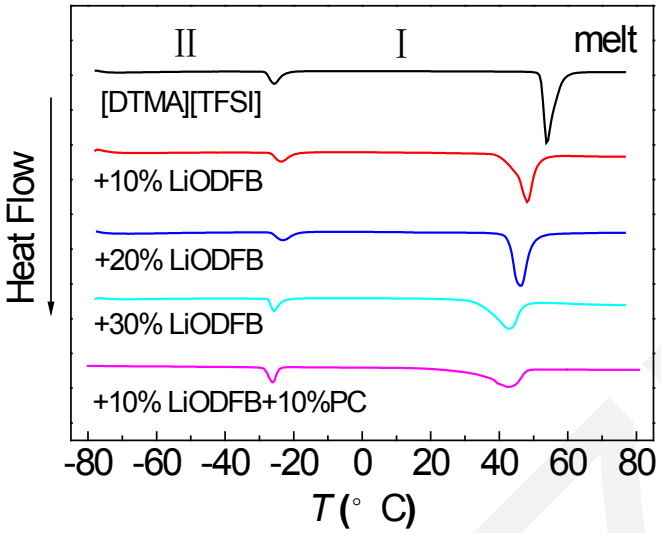


Fig. 1. DSC analysis of pure and [DTMA][TFSI] doped with LiODFB and PC

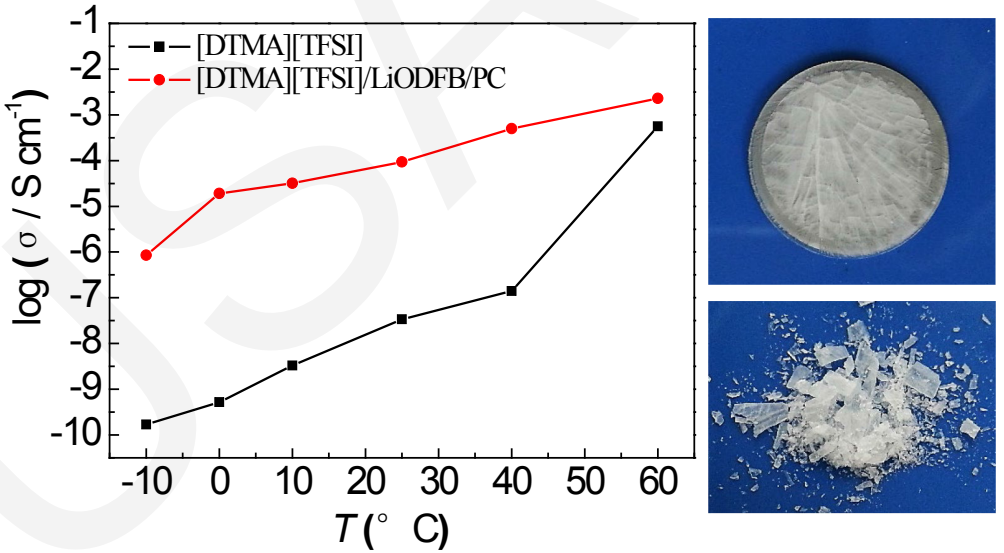
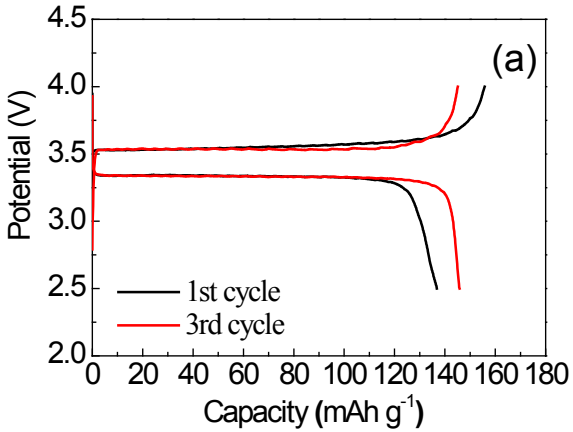


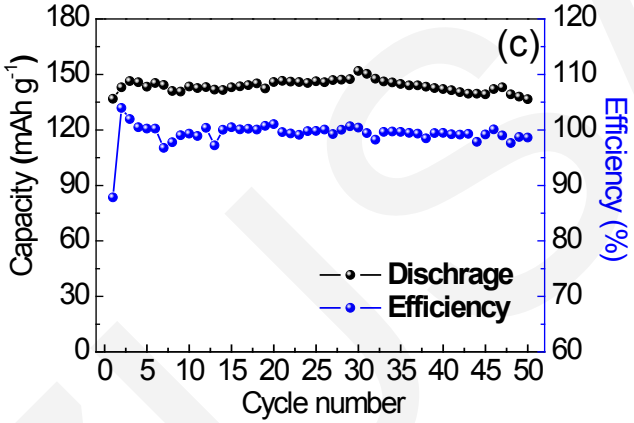
Fig. 2. The temperature dependence of conductivity curve and room temperature sample photos

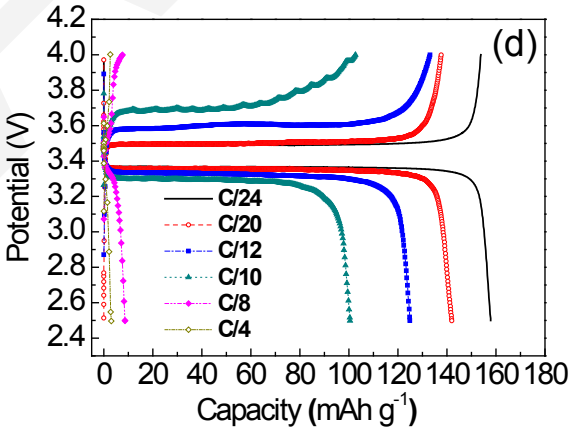
- *Plastic crystal temperature ranges from –26 ° C to 54 ° C.*
- *Doping LiODFB and PC in the neat OS IPC material , ionic conductivity significantly increased about 1 × 10^{-4} S cm^{-1} at 25 ° C.*

Three Representative Activities

■ The electrochemical properties of OS IPC composite electrolyte material







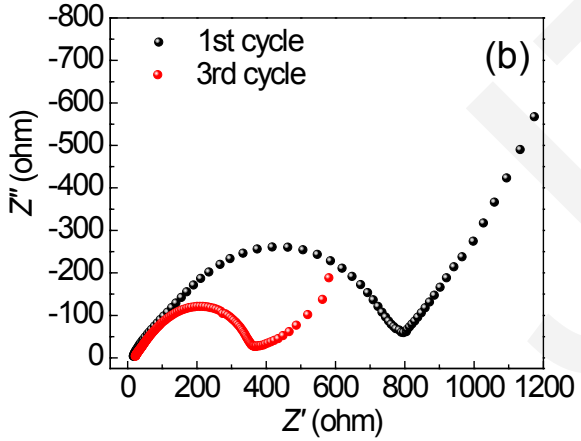


Fig. 3. The electrochemical properties of [DTMA][TFSI]-LiODFB-PC electrolyte in $LiFePO_4$/Li cell. (a) galvanostatic cycle curves, (b) impedance spectra, (C) cycle performance, (d) rate performance

- *The cell showed a discharge capacity of 144 mAh g^{-1} and coulomb efficiency of 99%.*
- *Capacity retained 94% after 50 cycles*

Conclusions

- A novel organosilicon-based ionic plastic crystal electrolyte [DTMA][TFSI] was synthesized with a wide plastic crystal temperature range (-26 - 54 ° C).
- Doping in [DTMA][TFSI] with 10%LiODFB and 10%PC, the composite showed a significantly increased ionic conductivity of 1×10^{-4} S cm^{-1} at 25 ° C.
- LiFePO4/Li cell with the composite as solid-state electrolyte exhibited good cycle stability.
- New organosilicon-based ionic plastic crystal composites have considerable potential used as solid-state electrolyte materials.