Licensing / Technology Offer

New Type of Porous Supramolecular Fluid Based on H_2O–Alkylammonium/Phosphonium Solutions (1/2)

FunNanoMat Lab

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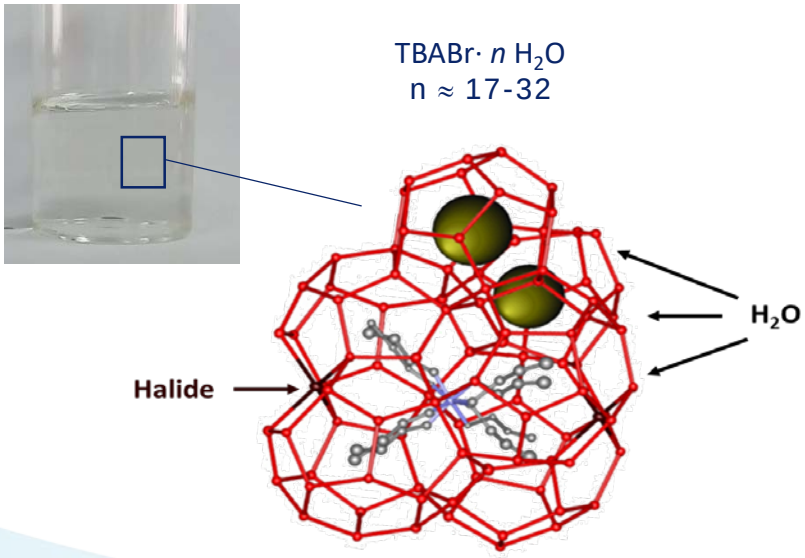
CiQUS Center for Research on Biological Chemistry and Molecular Materials

In the Liquid Structure:

- Both **water molecules** and **anions** (halide) are tightly hold in the H-bonded network structure with a reduced reactivity.
- **Small empty cages** can capture small-size non polar molecules (host-nanocages).



Water-ion framework enclosing TBA^+

Key Features (Energy Storage and Conversion):

- Do not restrict electrode selection
- Widening the potential stability window
- Energy density enhancement
- Alternative to highly concentrated “water-in-salt”
- Stable under atmospheric conditions
- Highly incompressible
- Properties could be optimized for different applications
- Could be extended to other pnictogen alkyl salts

By adjusting the concentration of tetrabutyl ammonium and phosphonium salts in water (≈1.5–2.0 m), hydrophobic solvation triggers the formation of a unique, highly incompressible supramolecular liquid, with a dynamic structure similar to clathrates, involving essentially all H_2O molecules of the solvent

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Patent family: ES2797556 (B2) / WO2022053735 (A1)

New supramolecular fluid – New electrolytes (2/2)

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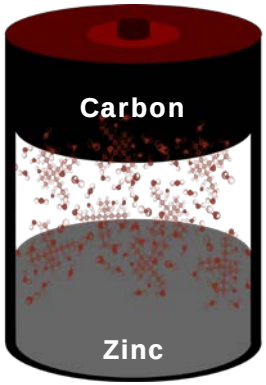
Internal Proof of Concept: Supramolecular Zn-Bromine Battery

Can we confine Br_2 to enhance coulombic efficiency avoiding side reactions?



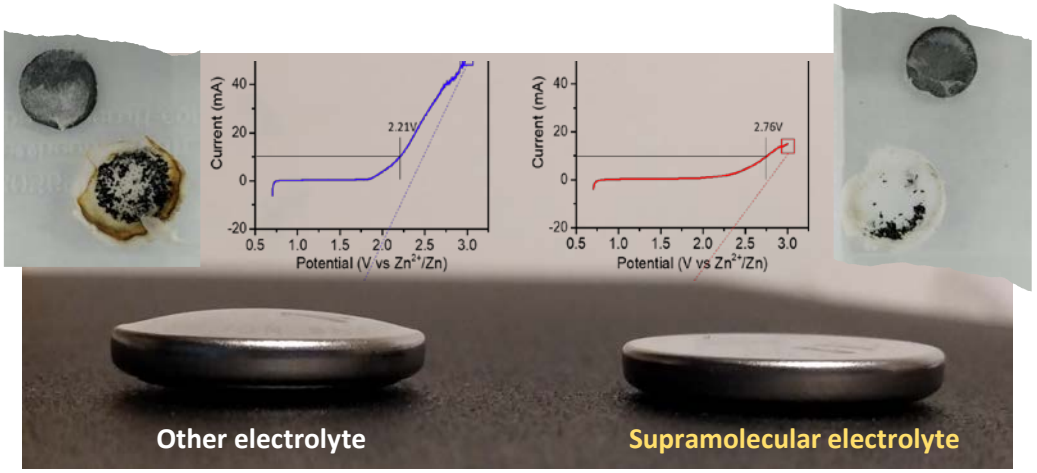
Cathode

Supramolecular Electrolyte

Anode

$2Br^- \rightleftharpoons Br_2 + 2\,e^-$ $E_o = 1.09$ V

$Zn^{2+} + 2e^- \rightleftharpoons Zn$ $E_o = -0.76$V



It improves the stability of a zinc-bromine battery, hindering the electrolyte decomposition, **and increase the capacity** due to the reversibility of Br^-/Br_2

Advantages of a supramolecular aqueous Zn-Bromine battery

- Metal-free electrode
- Large-scale compatible
- Cheap and eco-friendly
- No dendrite formation
- No water decomposition
- No cathodic intercalation of Zn^{2+}
- Use the Br^-/Br_2 redox process

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