Li-ion chemosensors for the detection of liquid electrolyte leakage

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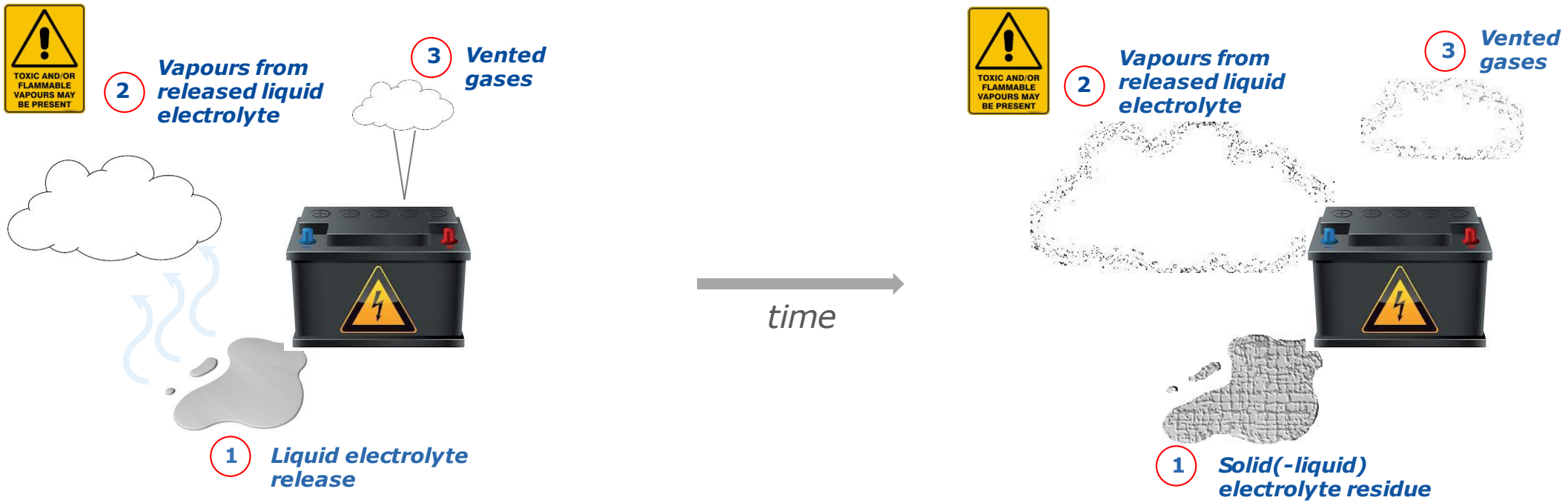
Li-ion chemosensors for the detection of liquid electrolyte leakage

Motivation

Commercially available lithium ionophores

State of affairs

Motivation



Possible approaches for detection of electrolyte release

1 Detection of Li-ion presence

2 + 3 Gas detection

Evolution of motivation for Li-ion sensing

1998

- *"The major interest for Li^+ analysis arises from the effective prophylactic and therapeutic action of Li^+ in various affective disorders…"*
  P. Bühlmann et al *Carrier-Based Ion-Selective Electrodes and Bulk Optodes. 2. Ionophores for Potentiometric and Optical Sensors,* Chem. Rev. 98 **(1998)** 1593-1687

2000

- *"…it is important to control the serum levels of lithium in patients under treatment for manic depression…"*
  B. Valeur, I. Leray, Design Principles of fluorescent molecular sensors for cation recognition, Coord. Chem. Rev., 205 **(2000)** 3-40

2017

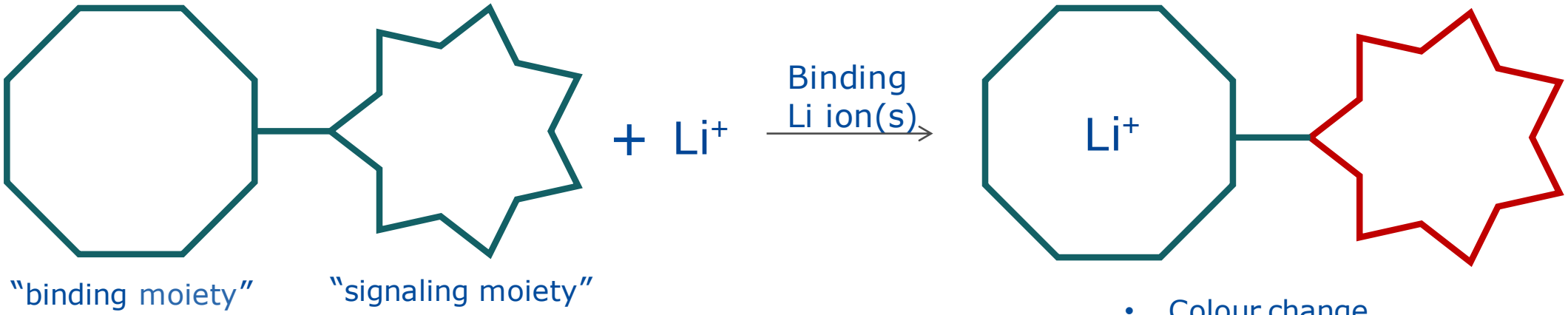
- *"Lithium salts… have been widely and effectively used in the treatment of bipolar disorders… The expanding use of **lithium ion batteries**, in particular, is likely to bring more **environmental exposure through leaching of landfill**."*
  M Kamenica et al, Lithium Ion Sensors, Sensors, 17 **(2017)** 2430

2021

- ***"Battery failure** may causes fire and sometimes explosions… So, the **detection and quantification of active lithium** is a primordial key to understand the lithium plating mechanisms…"*
  E. Villemin, O. Raccurt, *Optical lithium sensors*, Coord Chem Rev, 435 **(2021)** 213801

Li-ion chemosensor

Chemosensor – molecule able to simultaneously bind and signal the presence of other species[a].



- Colour change
- Fluorescence change

Ideal Chemosensor[b]
Change of visible colour

[a] F. Pina et al, *Chemosensors displaying pH controlled multistage fluorescence emission*, J. Photochem. Photobiol. A, 126 (1999), 65-69
[b] EVS21-E2TG-0100 [EC]Detection of liquid electrolyte by signalling Li ions

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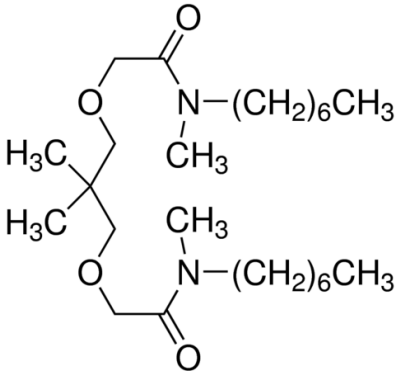
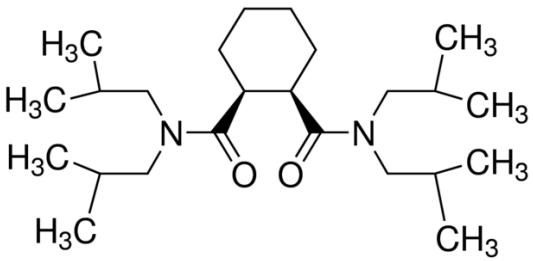
Commercially Available Lithium ionophores



LITHIUM IONOPHORE I



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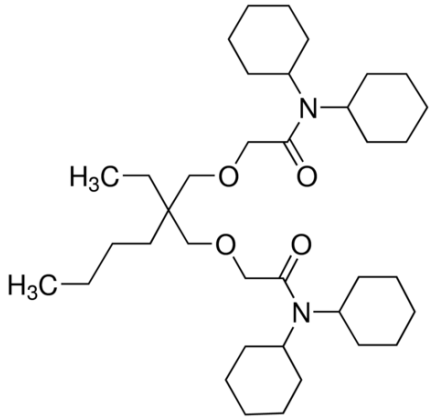

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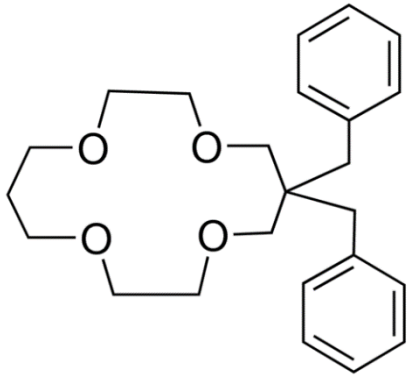

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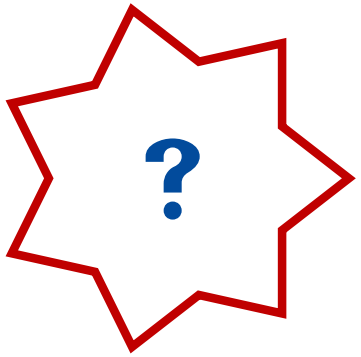
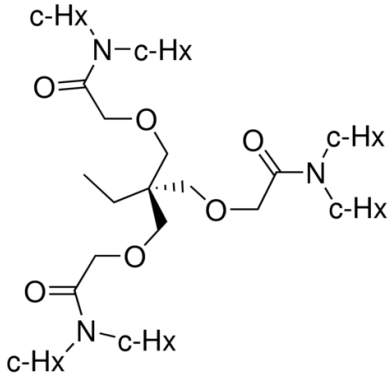


"signaling moieties?"



LITHIUM IONOPHORE VIII

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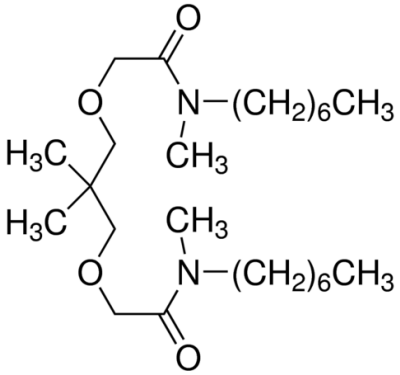
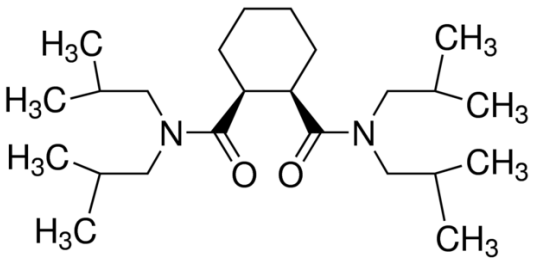
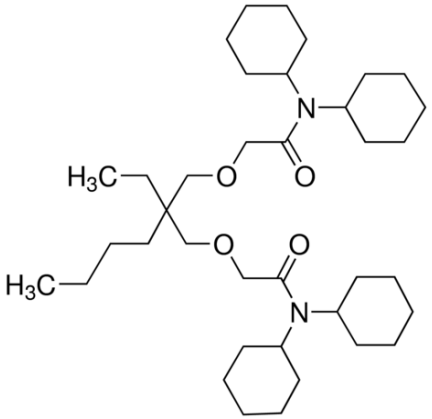
Commercially Available Lithium ionophores



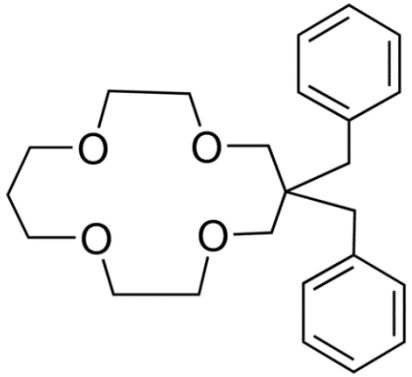
Lithium Ionophore I



Lithium Ionophore II

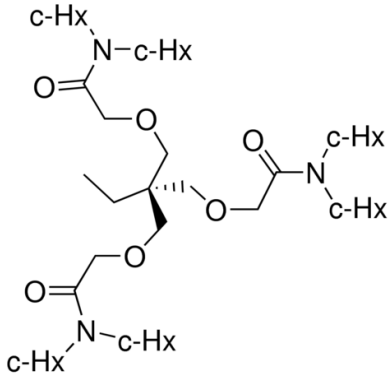


Lithium Ionophore IV



Lithium Ionophore VI

"signaling moieties?"



Lithium Ionophore VIII

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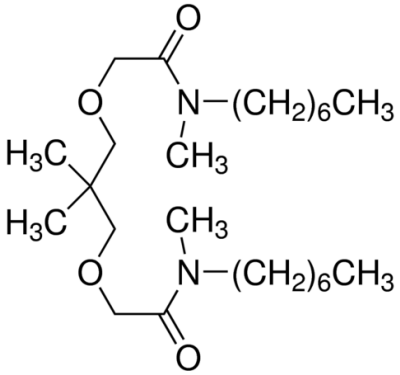
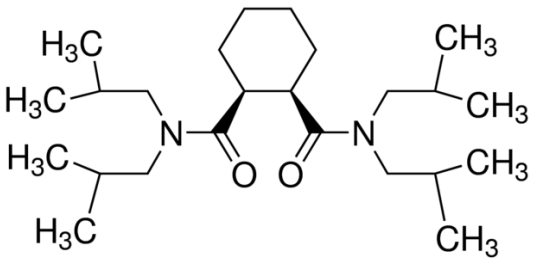
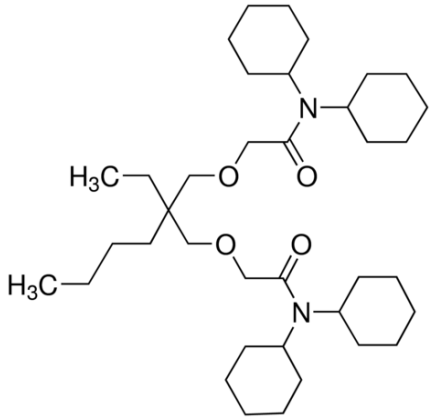
Commercially Available Lithium ionophores



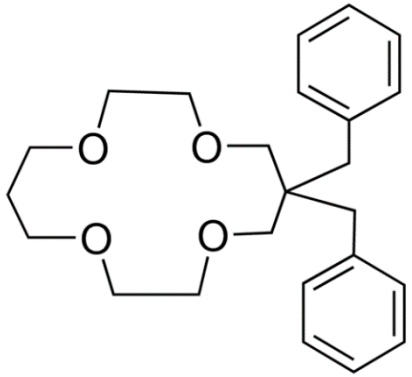
Lithium Ionophore I



Lithium Ionophore II

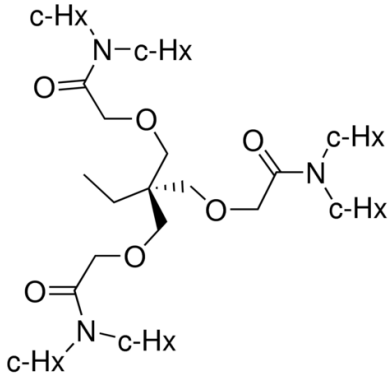


Lithium Ionophore IV



Lithium Ionophore VI

Electrochemical Transduction in Ion-Selective Electrodes



Lithium Ionophore VIII

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State of affairs

☑ JRC work provided a proof of concept for a coating with a chemosensor (8-hydroxyquinoline) to help identify liquid release of electrolyte from Li-ion batteries during testing.

☒ use of 8-HQ can't differentiate electrolyte release from other liquids.

☒ JRC will further explore commercially available ionophores to ascertain their suitability for detection of Li ions presence.

☐ JRC will explore collaboration with a partner that can synthesize and provide the identified chemosensor molecules for laboratory testing.

Thank you

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