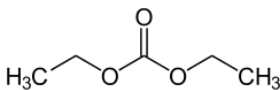
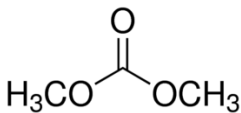
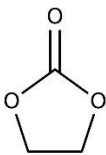
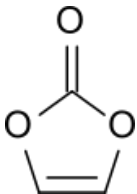


Table 3 Electrolyte chemicals and binders in LIB cells - potential reactions

Material	Chemical reaction(s)	Hazard	Comment
LiPF₆	$\text{LiPF}_6 (\text{s}) \leftrightarrow \text{LiF} (\text{s}) + \text{PF}_5 (\text{g})$ $\text{LiPF}_6 + \text{H}_2\text{O} \leftrightarrow \text{LiF} + 2\text{HF} + \text{POF}_3$ $\text{PF}_5 + \text{H}_2\text{O} \leftrightarrow 2\text{HF} + \text{POF}_3$	For HF H300 Fatal if swallowed H310 Fatal in contact with skin; Acute toxicity, dermal H314 Causes severe skin burns and eye damage H330 Fatal if inhaled Acute toxicity, inhalation	
DEC, C ₅ H ₁₀ O ₃		H226 Flammable liquid and vapour H315 Causes skin irritation H335 May cause respiratory irritation H351 Suspected of causing cancer H361 Suspected of causing cancer	Fire hazard; will cause the combustion of other LIB components
PVDF or FEP	$(\text{C}_2\text{H}_2\text{F}_2)_n + \text{fire} \rightarrow \text{HF}$ Incomplete combustion in a fire event may result in persistent contaminants: → various PFAS → CF ₄ (and other)	HF (see above) For CF ₄ ; Half-life (t _{1/2}) in atmosphere= 1000 years Global warming potential (GWP)= 4950 PFAS e.g. PFOA (may be formed during incomplete combustion) H302 : Acute toxicity, oral H332 : Acute toxicity, inhalation H351 : Suspected of causing cancer H360D : May damage the unborn child H362 : Reproductive toxicity H372 : Specific target organ toxicity, repeated exposure	Binder decomposition: May decompose to hydrogen fluoride when reaching 400 °C (Nissi 2019); Formation of PFAS if incomplete combustion at T < 850°C
Lithium ion salts based on highly fluorinated chemicals	Incomplete combustion in a fire event may result in persistent contaminants: → various PFAS → CF ₄ (and other)	see above	Formation of PFAS if incomplete combustion at T < 850°C

Material	Chemical reaction(s)	Hazard	Comment
DMC, C ₄ H ₈ O ₃		H225: Highly flammable liquid and vapour	Fire hazard; will cause the combustion of other LIB components
EC, C ₃ H ₄ O ₃		H302 Acute toxicity, oral H319 Causes serious eye irritation 372 Causes damage to organs through prolonged or repeated exposure	Complete combustion is likely even under 850 degrees
VC, C ₃ H ₂ O ₃		H302 Acute toxicity, oral H311 Acute toxicity, dermal H315 Causes skin irritation H317 May cause an allergic skin reaction H318 Causes serious eye damage 372 Causes damage to organs through prolonged or repeated exposure H411 Toxic to aquatic life with long lasting effects	Complete combustion is likely even under 850 degrees

Toxicity of lithium ion battery chemicals -overview with focus on recycling (excerpt), by Mats Zackrisson and Steffen Schellenberger, published June 18, 2020.

Available at - <https://www.diva-portal.org/smash/get/diva2:1787697/FULLTEXT01.pdf> (last accessed January 3, 2023).

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