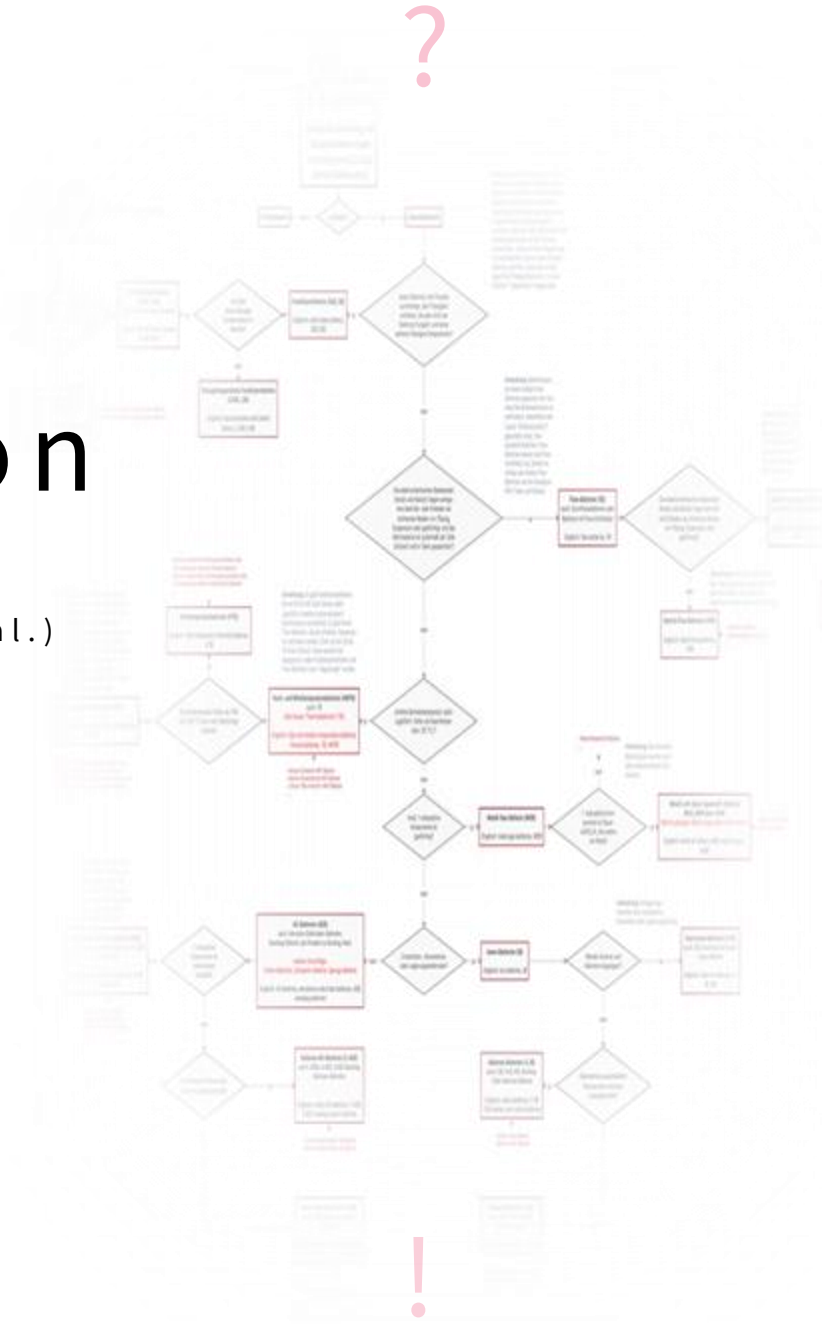
Examples of Classification

According to the
Scheme for Classification of Secondary Battery Types
in the Version dated December 15th 2025, KLiB e. V. (Dominik Sollmann et al.)



Download the scheme @
www.batterieforum-deutschland.de

Dominik Sollmann, Nils Wulfes (KLiB e. V.)

Page 3) Sodium – sulfur high-temperature battery

Page 4) Sodium – nickel chloride high-temperature battery

Page 5) Bromine – zinc hybrid flow battery

Page 6) Cerium – zinc hybrid flow battery

Page 7) Vanadium pentoxide – graphite potassium-ion battery

Page 8) Graphite – zinc dual-ion battery

Page 9) BiF_3 – $BiSnF_4$ – Zn fluoride-ion solid battery

Page 10) Aqueous NVP sodium-ion battery

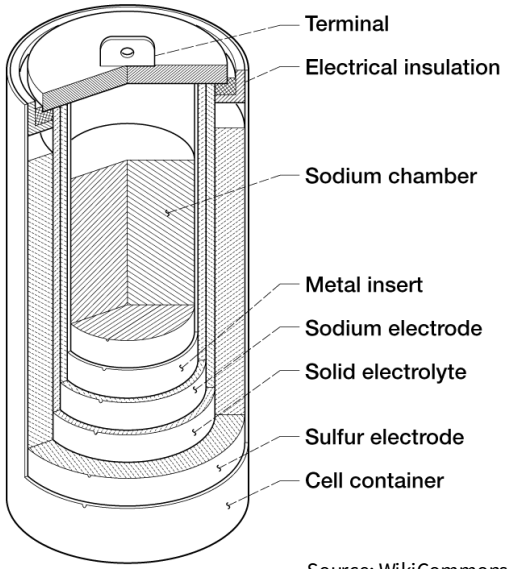
Page 11) Aqueous manganese oxide – zinc metal AE battery

Page 12) LFP – PEO lithium metal solid battery

Page 13) NMC811 – graphite/SiO_x lithium-ion battery

Page 14) Oxidic NMC811 – graphite/SiO_x lithium-ion LSB

Terms used in literature:
Sodium-beta battery, Na/S, Sodium-Sulfur, NaS

Anode:	Electrolyte:	Cathode:	
$Na_{(l)}$	ß“-$Al_2O_{2\,(s)}$	$S_{(s,l)}$	
$Na_2S_x \rightleftharpoons 2\,Na + xS$			
No active material outside the cell	 Source: WikiCommons	Active components are liquid during operation	
$T_{battery}$ = 290 – 390 °C			

More Info

Rechargeable?

Solid electrolyte and no other liquid components at operating temperature?

Flowing anolyte and catholyte?

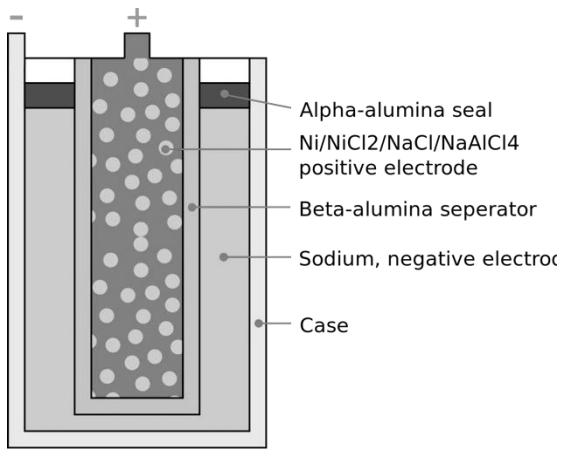
$T_{battery} > T_{ambient}$ (>25 °C)

$T_{battery}$ > 200 °C

Class: **High-temperature battery**

Name: Sodium – sulfur high-temperature battery

Terms used in literature:
Sodium-beta battery, $Na/NiCl_2$, ZEBRA-battery

Anode:	Electrolyte:	Cathode:	
$Na_{(l)}$	$ß“\text{-}Al_2O_{2\,(s)}$	$NiCl_{2\,(l)}$	
$NiCl_2 + 2\,Na \rightleftharpoons 2\,NaCl + Ni$			
No active material outside the cell			Active components are solid or liquid during operation
$T_{battery}$ = 220 – 450 °C			

Source: WikiCommons

More Info

Rechargeable?

Solid electrolyte and no other liquid components at operating temperature?

Flowing anolyte and catholyte?

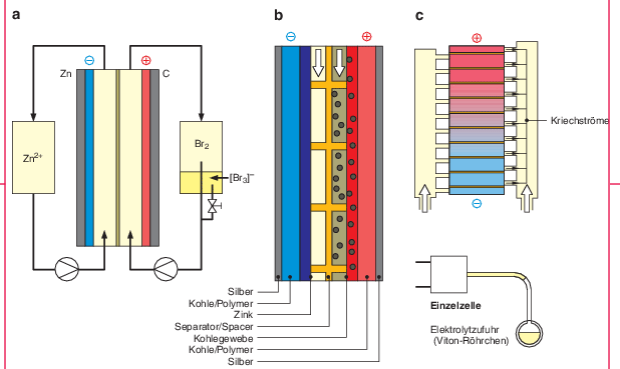
$T_{battery} > T_{ambient}$ (>25 °C)

$T_{battery}$ > 200 °C

Class: **High-temperature battery**

Name: Sodium – nickel chloride high-temperature battery

Terms used in literature:
Zinc-bromine flow battery, Zn/Br_2

Anode:	Electrolyte contains:	Cathode:	
$Br_{2\ (aq.)}$	$ZnBr_2$, $ZnCl_2$, Br_2, $C_7H_{16}BrN$	$Zn_{\ (s)}$	
$Br_{2\ (aq.)} + Zn_{(s)} \rightleftharpoons Zn^{2+}{}_{(aq.)} + 2\ Br^-{}_{(aq.)}$			
Flow architecture (active material is circulated outside the cell and stored in tanks)			Active components are solid or liquid during operation
$T_{battery}$ = $T_{ambient}$			Anolyte and catholyte are present as flowing media (liquid, suspension, or gaseous) at least during charging or discharging, but not during both processes.

Source: Redox-Flow-Batterien, Kurzweil et al., 2016

More Info

Rechargeable?
✓
Solid electrolyte and no other liquid components at operating temperature?
✗
Flowing anolyte and catholyte?
✓
Are reactants liquid or gaseous during charging and discharging?
✗

Class: **Hybrid flow battery**

Name: Bromine – zinc hybrid flow battery

Terms used in literature:
Zinc-cerium (redox) flow battery, Zinc-cerium battery

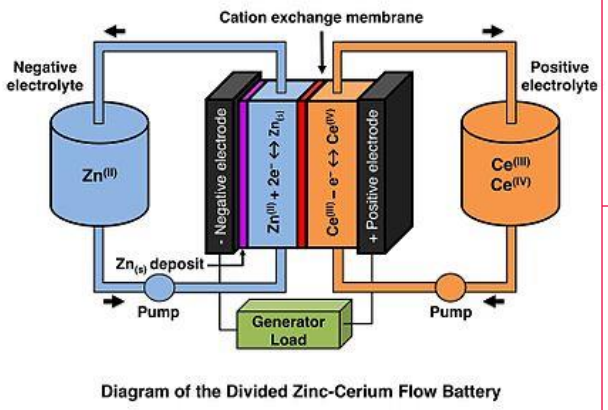
Anode:	Electrolyte: methane sulfonic acid (CH_3SO_3H)	Cathode:	
$Ce^{3+/4+}_{(aq.)}$		$Zn_{(s)}$	
$2\ Ce^{4+}_{(aq.)} + Zn_{(s)} \rightleftharpoons Zn^{2+}_{(aq.)} + 2\ Ce^{3+}_{(aq.)}$			
Flow architecture (active material is circulated outside the cell and stored in tanks)			Active components are solid or liquid during operation
$T_{battery} = T_{ambient}$			Anolyte and catholyte are present as flowing media (liquid, suspension, or gaseous) at least during charging or discharging, but not during both processes.

Diagram of the Divided Zinc-Cerium Flow Battery

Source: WikiCommons

More Info

Rechargeable?

Solid electrolyte and no other liquid components at operating temperature?

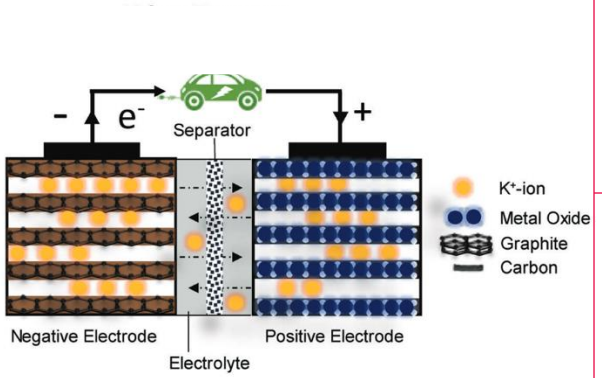
Flowing anolyte and catholyte?

Are reactants liquid or gaseous during charging and discharging?

Class: **Hybrid flow battery**

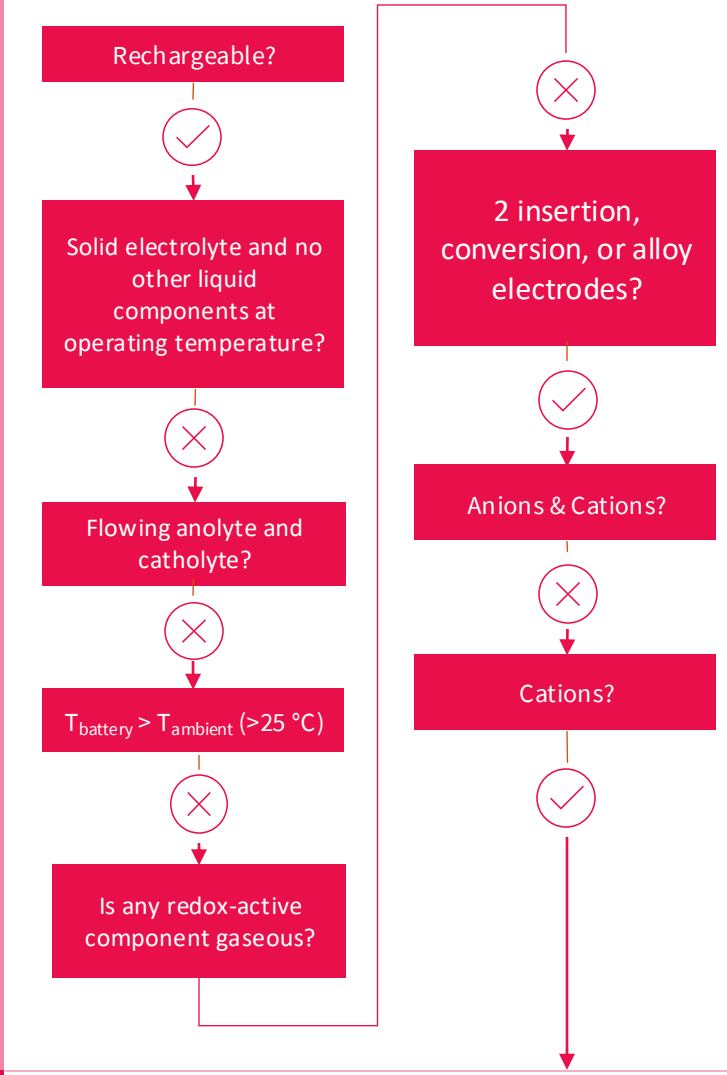
Name: Cerium – zinc hybrid flow battery

Terms used in literature:
K-Vanadium Pentoxide (potassium-ion) battery

Anode:	Electrolyte:	Cathode:	
Graphit/K $_{(s)}$	KPF_6/PC	$V_2O_{5\ (s)}$	
Cations: K^+			
No active material outside the cell			Active components are solid or liquid during operation
$T_{battery}$ = $T_{ambient}$			

Quelle: Hwang et al., 2018

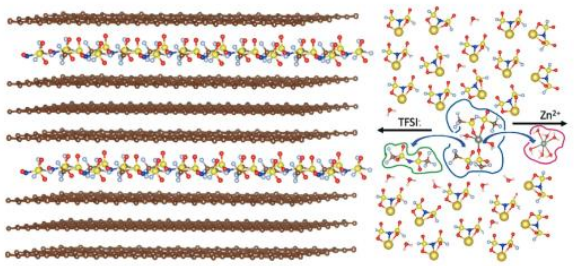
More Info



Class: **Cation battery**

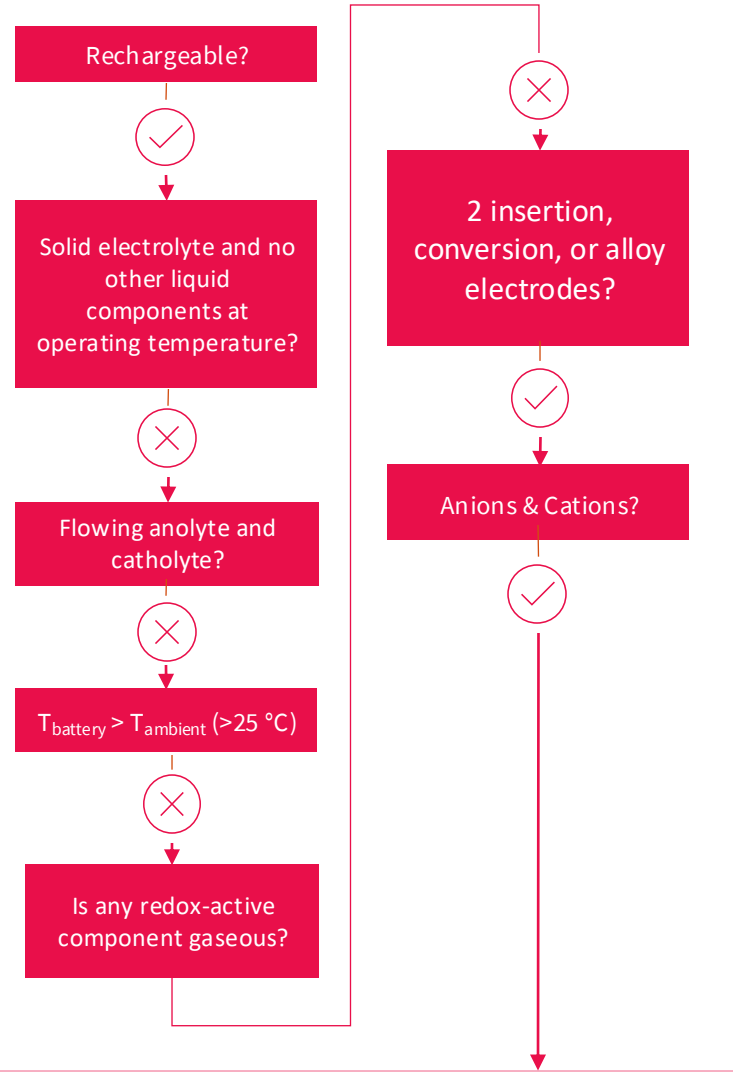
Name: Graphite – vanadium pentoxide potassium-ion battery

Terms used in literature:
Graphite-zinc, GZn, Graphite || Zn metal dual-ion battery

Anode:	Electrolyte:	Cathode:
$Zn_{(s)}$	„water-in-bisalt“	$graphite_{(s)}$
Anions: $TFSI^-/FSI^-$ || Cations: Na^+ and Zn^{2+}		
No active material outside the cell		Active components are solid or liquid during operation
$T_{battery} = T_{ambient}$		

Source: Rodríguez-Pérez et al., 2020

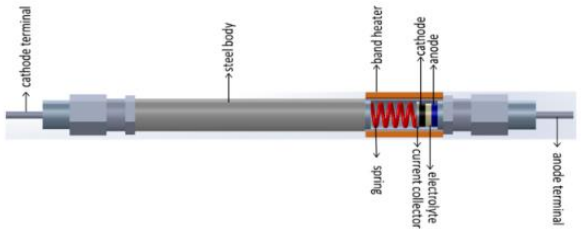
More Info



Class: **Dual-ion battery**

Name: Graphite – zinc-metal dual-ion battery

Terms used in literature:
Room temperature fluoride-ion (FIB) battery, F/Zn or Sn

Anode:	Electrolyte:	Cathode:	
Zn or $Sn_{(s)}$	Tetragonal $BaSnF_{4\,(s)}$	$BiF_{3\,(s)}$	
Anions: F^-			
No active material outside the cell	 Source: Mohammad et al., 2018		All compontents are solid during operation
$T_{battery}$ = 25 °C, 60 °C, 100 °C, 150 °C			

More Info

Rechargeable? → ✓

Solid electrolyte and no other liquid components at operating temperature? → ✓

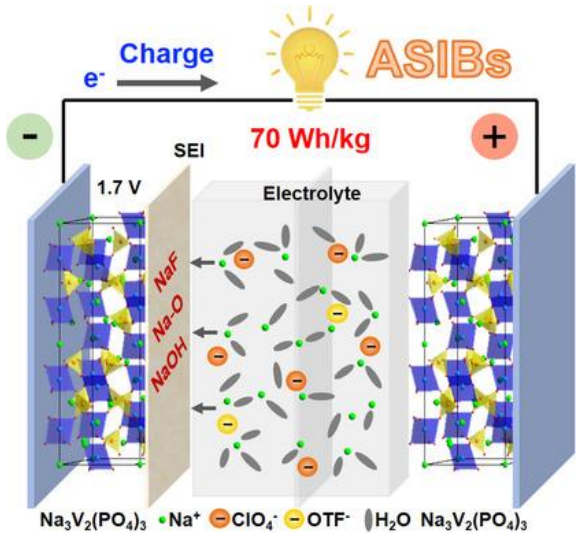
Liquid components? → ✗

Deposition of the electrolyte from gas phase or plasma? → ✗

Class: **Thick-film (Solid(-state)) battery**

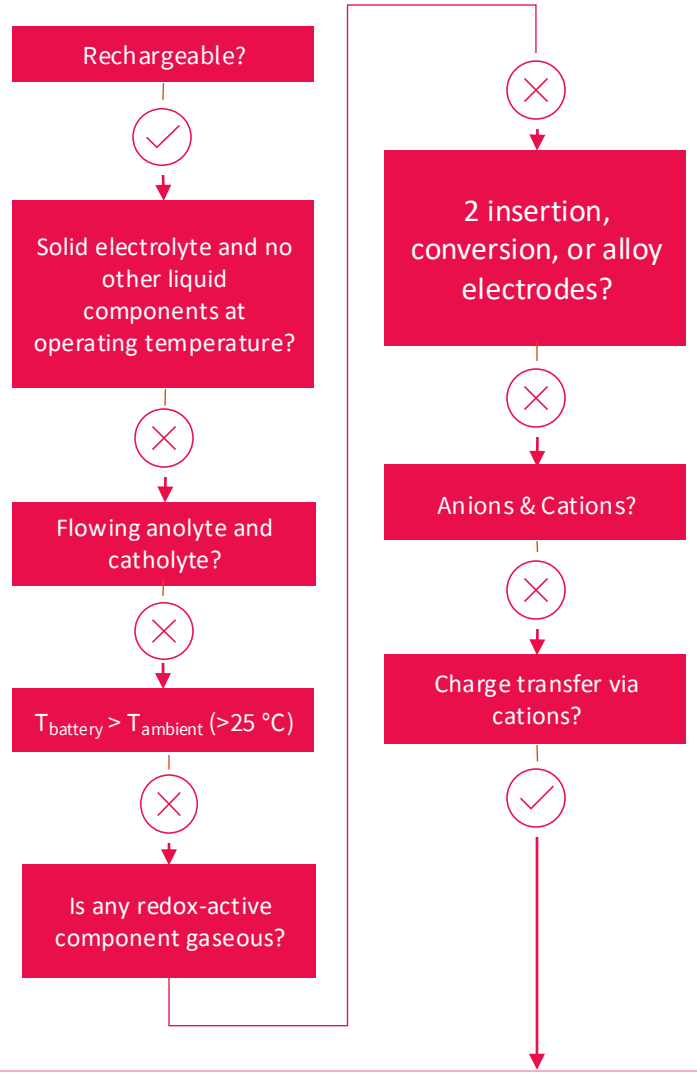
Name: BiF_3-$BiSnF_4$-Zn fluoride-ion AS(S)B
BiF_3-$BiSnF_4$-Sn fluoride-ion AS(S)B

Terms used in literature:
Aqueous $Na_3V_2(PO_4)_3$ sodium-ion battery (SIB)

Anode:	Electrolyte:	Cathode:	
$Na_3V_2(PO_4)_3$ (s)	$NaClO_4$ (aq.), $NaOTF_{(aq.)}$	$Na_3V_2(PO_4)_3$ (s)	
Cations: Na^+			
No active material outside the cell			Active components are solid or liquid during operation
$T_{battery}$ = $T_{ambient}$			

Source: Jin et al., 2021

More Info

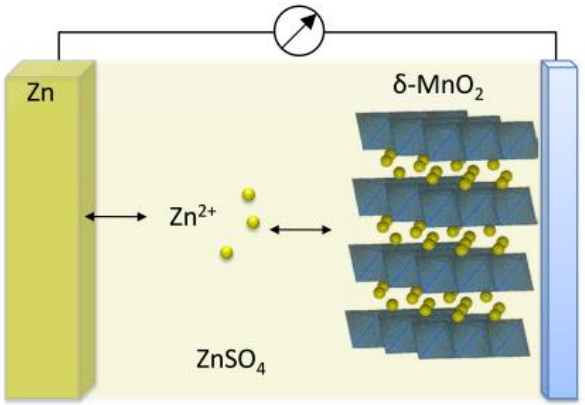


Class: **Cation battery**

Name: Aqueous NVP – sodium-ion battery

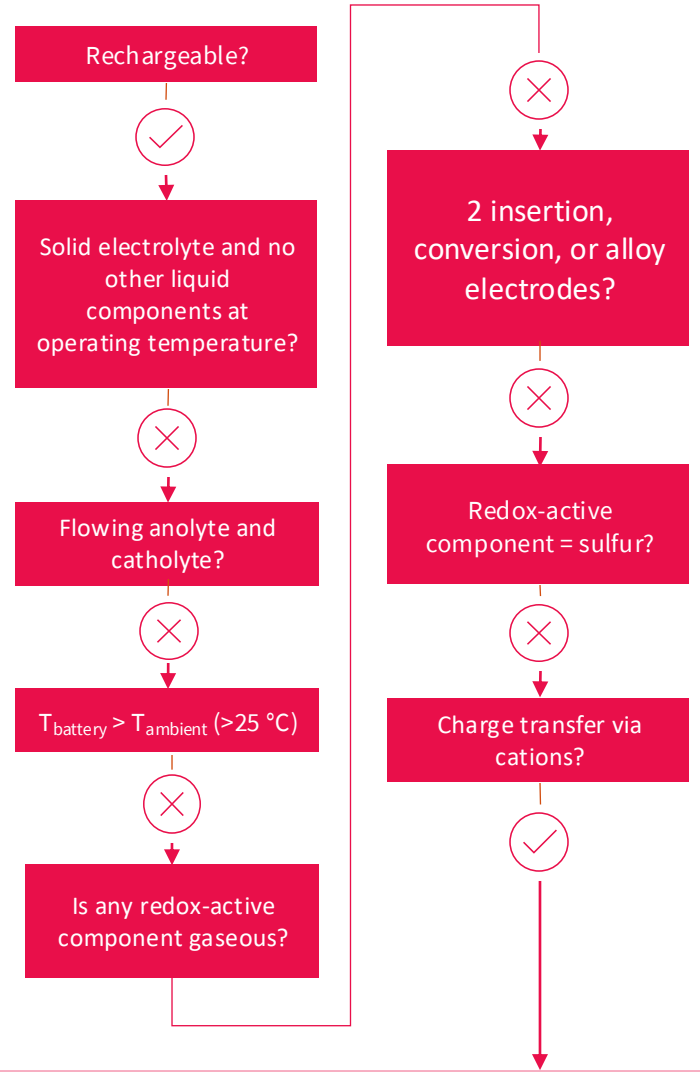
Terms used in literature:
Aqueous zinc-ion battery (ZIB)

Anode:	Electrolyte:	Cathode:
$Zn_{(s)}$	$ZnSO_{4\,(aq.)}$	$\alpha/\delta\text{-}MnO_{2\,(s)}$

No active material outside the cell		Active components are solid or liquid during operation
$T_{battery} = T_{ambient}$		

Source: Dechema., 2021

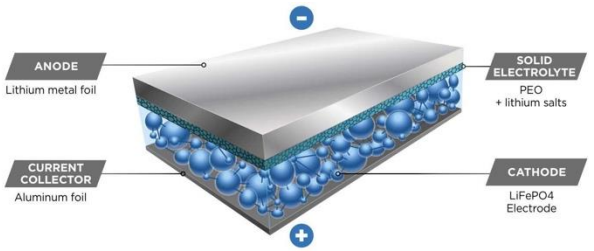
More Info



Class: **Cation AE battery**

Name: Aqueous Manganese oxide – zinc-metal AEB

Terms used in literature:
LMP, solid-state lithium metal polymer battery

Anode:	Electrolyte:	Cathode:	
$Li_{(s)}$	PEO + Li-salts $_{(s)}$	$LiFePO_{4\ (s)}$	
Cations: Li^+			
No active material outside the cell	 Source: Inside EVs., 2021	Active compontents are solid during operation
$T_{battery} = 60\ °C$ > $T_{ambient} = 25\ °C$		PEO-based solid-state electrolyte with lithium conductive salt, no liquid components

More Info

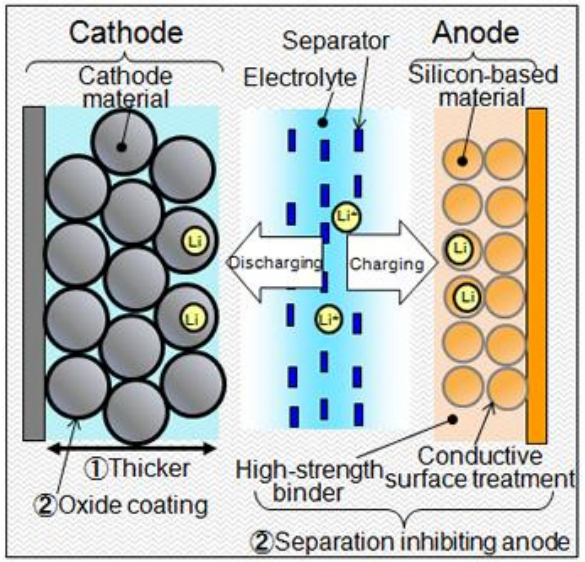
Rechargeable?
→ ✓
Solid electrolyte and no other liquid components at operating temperature?
→ ✓
Liquid components?
→ ✗
Deposition of the electrolyte from gas phase or plasma?
→ ✗

Class: **Thick-film**

Name: **All-solid battery**

Thick-film LFP – PEO – lithium metal AS(S)B

Terms used in literature:
Lithium-ion battery, gr/Si || NCM(811)

Anode:	Electrolyte:	Cathode:	
graphite/$SiO_{x\,(s)}$	$LiPF_6$ in EC/DMC	NMC 811 $_{(s)}$	
Cations: Li^+			
No active material outside the cell			Active components are solid or liquid during operation
$T_{battery}$ = $T_{ambient}$			

Source: Hitachi 2014

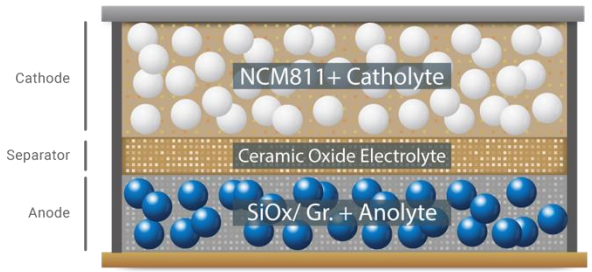
More Info

Rechargeable?
Solid electrolyte and no other liquid components at operating temperature?
Flowing anolyte and catholyte?
$T_{battery} > T_{ambient}$ (>25 °C)
Is any redox-active component gaseous?
2 insertion, conversion, or alloy electrodes?
Anions & cations?
Charge transfer via cations?

Class: **Cation battery**

Name: NMC811 – graphite/SiO_x lithium-ion battery

Terms used in literature:
ProLogium SiO_x anode SSB

Anode:	Electrolyte:	Cathode:	
graphite/SiO_x (s)	liquid assisted oxidic solid-state electrolyte (s/l)	NMC 811 (s)	
Cations: Li^+			
No active material outside the cell			Active components are solid or liquid during operation
$T_{battery}$ > $T_{ambient}$ = 25 °C			Oxidic solid-state electrolyte + unspecified liquid

Source: Prologium

More Info

Rechargeable?

Solid electrolyte and no other liquid components at operating temperature?

Liquid components?

Class: **Liquid-assisted Solid(-state) battery**

Name: Oxidic NMC811 – graphite/SiO_x lithium-ion LS(S)B