Electronic Supplementary Material (ESI) for Energy & Environmental Science

Supporting Information for

Room-Temperature Stationary Sodium-Ion Batteries for Large-Scale Electric Energy Storage

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Table S1 Reported electrode materials for room-temperature sodium-ion batteries

	Formula	Voltage (V *vs.* Na^+/Na)	Capacity (mAh/g)	Redox Couples	Coulombic Efficiency (%)		Cycling Performance (number)	Structural stability	References
					Initial cycle	After cycling			
Cathode materials									
	O3-$NaFeO_2$	3.3 V	~80 (2.5 - 3.4 V)	Fe^{4+}/Fe^{3+}	-		75% (30)	poor	1,2

	O3-$NaMnO_2$	2.63 V, 2.7-3.8 V	185 (2-3.8 V)	Mn^{4+}/Mn^{3+}	~86%	~90%	~71% (20)	moderate	3
	O3-$NaNiO_2$	2.5-3.5 V	120 (1.25-3.75 V)	Ni^{4+}/Ni^{3+}	83.8%	99.2%	94% (20)	moderate	4
	O3-$NaCrO_2$	~3 V	120 (2-3.6 V)	Cr^{4+}/Cr^{3+}			~83% (50)	good	5, 6
	O3-Na_xVO_2	~1.7 V, 1.8-2.4 V	120 (1.2-2.4 V)	V^{4+}/V^{3+}	-	-	~100% (14)	moderate	7, 8
	O3-$Na_xFe_{0.5}Mn_{0.5}O_2$	1.5-4.2 V	100-110 (1.5-4.2 V)	Fe^{4+}/Fe^{3+} Mn^{4+}/Mn^{3+}	-	-	~65% (30)	good	9
	O3-$NaNi_{0.5}Mn_{0.5}O_2$	2.2-3.8 V	100-125	Ni^{4+}/Ni^{2+}			75% (50)	good	10
	O3-$NaNi_{1/3}Mn_{1/3}Co_{1/3}O_2$	2.5-3.75 V	120 (2.5-3.75 V)	Ni^{4+}/Ni^{2+} Co^{3+}/Co^{4+}			~96% (50)	moderate	11
	O3-$NaNi_{1/3}Mn_{1/3}Fe_{1/3}O_2$	2.0-4 V	130	Ni^{4+}/Ni^{3+}	~70%	>99%	77% (150)	good	12
	P2-Na_xCoO_2	2.0-3.9 V	~120	Co^{4+}/Co^{3+}	-	-	-	good	13-15
	*P2-Na_xMnO_2	2.0-3.8 V	~140	Mn^{4+}/Mn^{3+}	-	-	~30% (10)	poor	16
	P2-Na_xVO_2	1.6 V, 1.6-2.4 V	~100	V^{4+}/V^{3+}	-	-	110% (10)	moderate	7
	*P2-$Na_{2/3}Fe_{0.5}Mn_{0.5}O_2$	1.5-4.3 V	190 (1.5-4.3 V)	Me^{4+}/Me^{3+} (Me=$Fe_{0.5}Mn_{0.5}$)	-	-	~80% (30)	good	9
	P2-$Na_{2/3}Co_{2/3}Mn_{1/3}O_2$	1.5-4.0 V	~90	Co^{4+}/Co^{3+}	-	-	-	good	17
	P2-$Na_{2/3}Ni_{1/3}Mn_{2/3}O_2$	3.0-4.5 V	160	Ni^{4+}/Ni^{2+}	-	-		good	18
	*P2-$Na_{0.45}Ni_{0.22}Co_{0.11}Mn_{0.66}O_2$	2.1-4.3 V	135	Mn^{4+}/Mn^{3+}, Co^{4+}/Co^{3+}, Ni^{4+}/Ni^{2+}	-	99.7%	72% (275)	good	19
	*P2-$Na_{0.67}Ni_{0.15}Co_{0.2}Mn_{0.65}Al_{0.05}O_2$	2.3V,3.65V, 4.25 V	141		130%	>99%	88% (50)		20
	P2-$NaLi_{0.2}Ni_{0.25}Mn_{0.75}O_y$	2.0-4.2 V	~100	Ni^{4+}/Ni^{2+}	85%	>99%	~98% (50)	good	21

	*$Na_{0.44}MnO_2$	2.0-4.0 V	~110	Mn^{4+}/Mn^{3+}		~100%	77% (1000)	good	22, 23
Phosphates	$NaFePO_4$ (Olivine)	~2.9 V	~120	Fe^{3+}/Fe^{2+}	-	-	-	-	24, 25
	$Na_3V_2(PO_4)_3$	3.4 V	107	V^{4+}/V^{3+}	98.7%	99.8%	93% (80)	excellent	26-28
	$NaTi_2(PO_4)_3$	2.1 V	~120	Ti^{4+}/Ti^{3+}	-	-	60% (30)	excellent	29
	$Na_{2-x}Fe_{1+x/2}P_2O_7$	2.5 V, 3 V	~80	Fe^{3+}/Fe^{2+}	-	-	115% (80)	good	30-32
	$Na_2MnP_2O_7$	3.6 V	~80 (2-4.5 V)	Mn^{3+}/Mn^{2+}	~80%	-	-	good	32
	$Na_2CoP_2O_7$	3.0 V	~80 (1.5-4.5 V)	Co^{3+}/Co^{2+}	-	-	-	good	33
	$Na_4Fe_3(PO_4)_2P_2O_7$	3.2 V	~100 (1.5-4.3 V)	Fe^{3+}/Fe^{2+}	-	-	~95% (10)	good	34
	Na_2FePO_4F	~3.0 V	~110	Fe^{3+}/Fe^{2+}			~75% (20)	good	35, 36
	Na_2MnPO_4F	~3.6 V	~110 (1-4.5 V)	Mn^{3+}/Mn^{2+}	-	-	-	good	37
	$Na_2Fe_{0.5}Mn_{0.5}PO_4F$	3.0 V, 3.53 V	~110	Fe^{3+}/Fe^{2+}, Mn^{3+}/Mn^{2+}			~80% (20)	good	35
	$Na_3V_2(PO_4)_2F_3$	3.7 V, 4.2 V	~110	V^{4+}/V^{3+}	-	-	~91% (30)	good	38, 39
	$Na_3V_2O_{2x}(PO_4)_2F_{3-2x}$ ($0 \leq x \leq 1$)	3.6 -4.0 V	~80	V^{4+}/V^{3+}	-	-	~75% (50)	good	40, 41
	$NaV_{1-x}Cr_xPO_4F$	3.4 V, 4.2 V	~83	V^{4+}/V^{3+}	82-90 %	-	~73-91% (20)	good	42, 43
Hexacyanoferra	$K_xNiFe(CN)_6$	~3.29 V	~ 60	$Fe(CN)_6^{3-}$/ $Fe(CN)_6^{4-}$	-	-	100% (5000)	excellent	44
	$KFe_2(CN)_6$	2.9 V, 3.6V	~100	$Fe(CN)_6^{3-}$/ $Fe(CN)_6^{4-}$	60%	80%	100% (30)	excellent	45
	$Na_{1+x}MnFe(CN)_6$	~3.4 V	~120	$Fe(CN)_6^{3-}$/	~93%	<95%	96% (30)	excellent	46

				$Fe(CN)_6^{4-}$					
	$Na_4Fe(CN)_6$	~3.37 V	~87	$Fe(CN)_6^{3-}$/ $Fe(CN)_6^{4-}$	-	~100%	88% (500)	excellent	47
Fluorides	$NaFeF_3$	~2.7 V	130 (1.5-4 V)	Fe^{3+}/Fe^{2+}			~61% (30)	good	48-50
	FeF_3/C	~2.2 V	~30	Fe^{3+}/Fe^{2+}	50%	-	-	good	51
Organic cathodes	Aniline-nitroaniline copolymer	~3.2 V	~180	Anion doping	~80%	~95%	96% (50)	excellent	52
	bipolar porous organic electrode (BPOE)	~3.3 V, ~2.3 V	~55 (p-doping), ~185 (n-doping)	Anion doping/ cation doping	~90%	~100%	80% (7000)	excellent	53
						In a full cell			
	$(C_{12}H_{10}NSO_3$-doped $(C_4H_3N)_n$	~2.5 V, ~3.7 V	115	Anion doping	-		~80% (50)	excellent	54
				Anode materials					
Carbon	Hard carbon	1.2-0.1 V, 0.1-0 V	240	-	~80%	99.5%	~88% (500)	moderate	55
Oxides	Fe_3O_4	1.5-4 V	~160	-			50% (30)	moderate	56
	TiO_2	2.5-0.9 V		-				moderate	
	Sb_2O_4	0.5-0.9 V, 0.4 V, 0.01-0.17 V	896	-	100%	-	-	-	57
	$NaCo_2O_4$	0.01-3 V	200	-	32%	-	-	moderate	58
	$Li_4Ti_5O_{12}$	0.91 V	155	Ti^{4+}/Ti^{3+}	81%	~99.5	104% (50)	good	59, 60

						%			
	$Na_2Ti_3O_7$	~0.3 V	175	Ti^{4+}/Ti^{3+}	50-60 %	-	~33% (50)	moderate	61-65
Alloys	Sb/C	0-2 V	610	Alloy reaction	85%	99%	94% (100)	moderate	66
	SnSb/C	0-1.2 V	544	Alloy reaction	60%	98.3%	80% (50)	moderate	67
	Amorphous P/C	~0.4 V	~1800	Alloy reaction	85%	>98%	94% (30)	moderate	68,69
Organic	$Na_2C_8H_4O_4$	~0.43 V	250	Chemical bonding	60%	99.5%	82.7% (60)	moderate	70
	$Na_2C_6O_6$	1.0-2.9 V	270	Chemical bonding	-	-	60% (40)	moderate	71

Note: * Partial of the capacity was compensated by the sodium anode during the first discharge process.

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