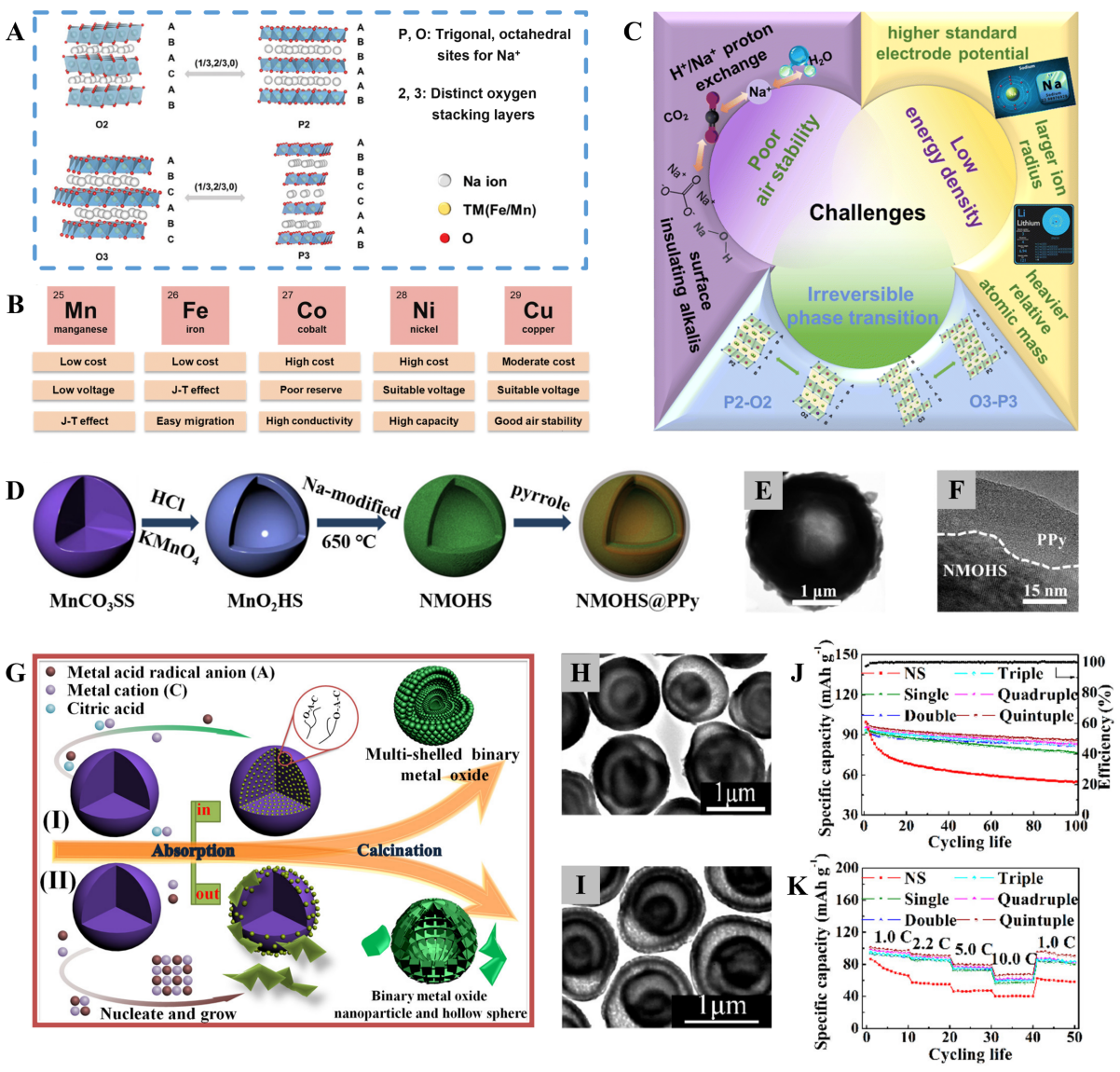
A
O2
P2
O3
P3
(1/3,2/3,0)
P, O: Trigonal, octahedral sites for Na+
2, 3: Distinct oxygen stacking layers
Na ion
TM(Fe/Mn)
O
B
25 Mn manganese
26 Fe iron
27 Co cobalt
28 Ni nickel
29 Cu copper
Low cost
Low voltage
J-T effect
Low cost
J-T effect
Easy migration
High cost
Poor reserve
High conductivity
High cost
Suitable voltage
High capacity
Moderate cost
Suitable voltage
Good air stability
C
H+/Na+ proton exchange
H2O
Na+
CO2
Poor air stability
insulating alkalis surface
Challenges
Low energy density
higher standard electrode potential
larger ion radius
heavier relative atomic mass
Irreversible phase transition
P2-O2
O3-P3
D
HCl
KMnO4
Na-modified
650 °C
pyrrole
MnCO3SS
MnO2HS
NMOHS
NMOHS@PPy
E
1 μm
F
PPy
NMOHS
15 nm
G
Metal acid radical anion (A)
Metal cation (C)
Citric acid
Multi-shelled binary metal oxide
(I)
in
Absorption
Calcination
(II)
out
Nucleate and grow
Binary metal oxide nanoparticle and hollow sphere
H
1μm
I
1μm
J
NS
Single
Double
Triple
Quadruple
Quintuple
Specific capacity (mAh g-1)
Efficiency (%)
Cycling life
K
1.0 C
2.2 C
5.0 C
10.0 C
1.0 C
Specific capacity (mAh g-1)
Cycling life