

Introduction

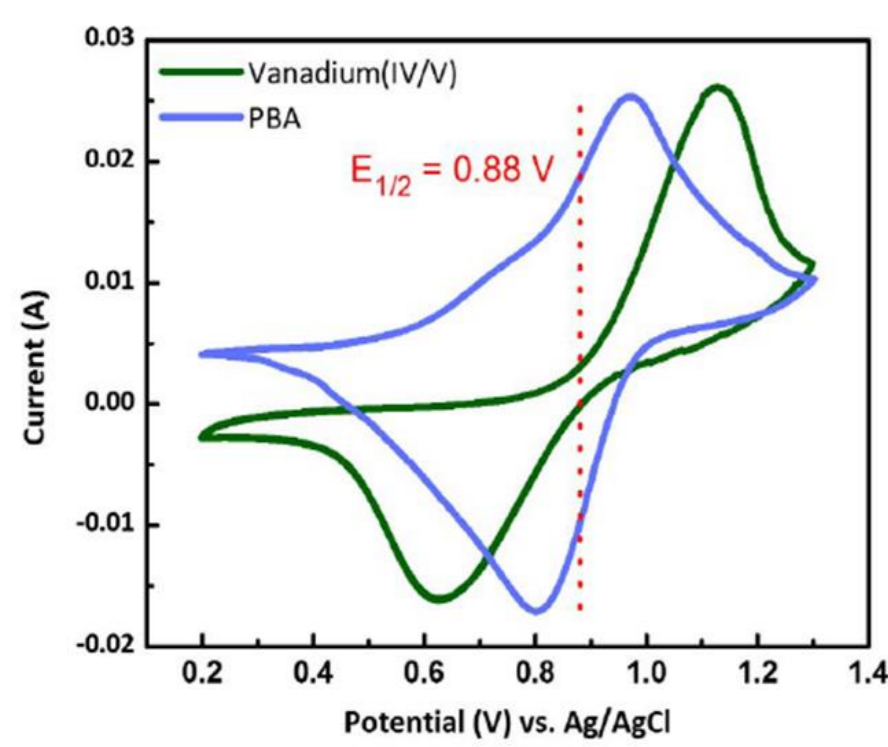
- The **redox flow battery (RFB)** is a type of electrochemical cell where chemical energy is provided by two chemical components dissolved in liquids that are pumped through the system on separate sides of a membrane.
- Vanadium redox flow battery (VRFB)** employs vanadium ions as charge carriers. The battery uses vanadium's ability to exist in a solution in four different oxidation states to make a battery with a single electroactive element instead of two. Vanadium batteries are typically used for grid energy storage.
- Redox targeting (RT)** is an approach by employing redox mediators (RMs) dissolved in electrolyte to chemically address the poorly conducting battery materials through a RT process and increase the charge capacity and energy density.
- Cyclic Voltammetry (CV)** is an electrochemical technique which measures the current that develops in an electrochemical cell under conditions where voltage is in excess of that predicted by the Nernst equation.

Experimental

- Dispersion solution**
6mL ethanol and 0.18mL PANI +Fe-Co PBA powder
6mL ethanol and 0.1g K-V-Fe PBA powder
- CV measurement**
CV was carried out on a rotating disk electrode (RDE)
Scan rate : 50mV
electrolyte : 0.1M $VOSO_4 + 3M H_2SO_4$
No RPM
CE : Pt wire
RE : Ag/AgCl in KCl aqueous solution

Results and Discussion

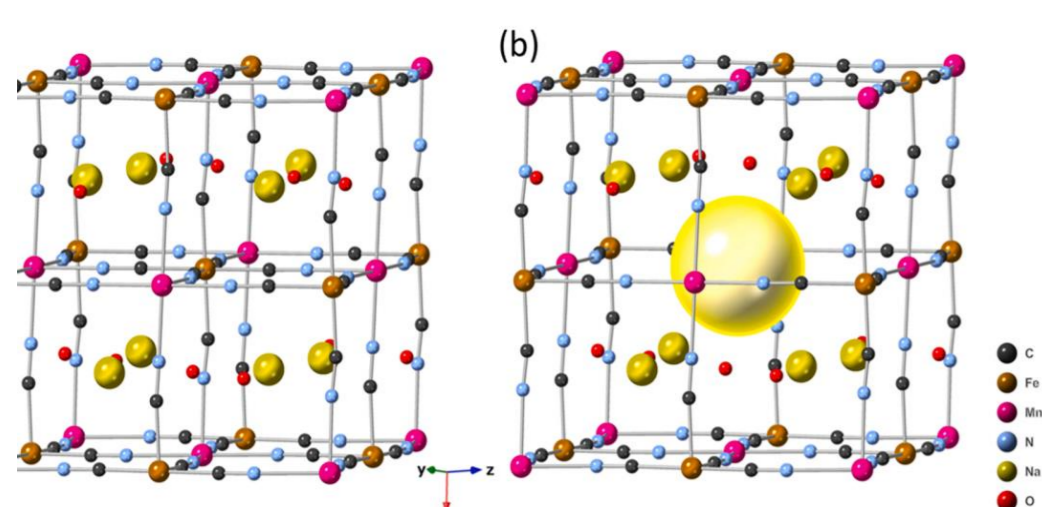
1. Principle of Redox Targeting



In order to promote the redox targeting reaction, two redox mediators, one with potential higher and the other with potential lower than the material are generally employed so that there is a larger driving force for the interfacial charge-transfer process

2. Materials used in other batteries

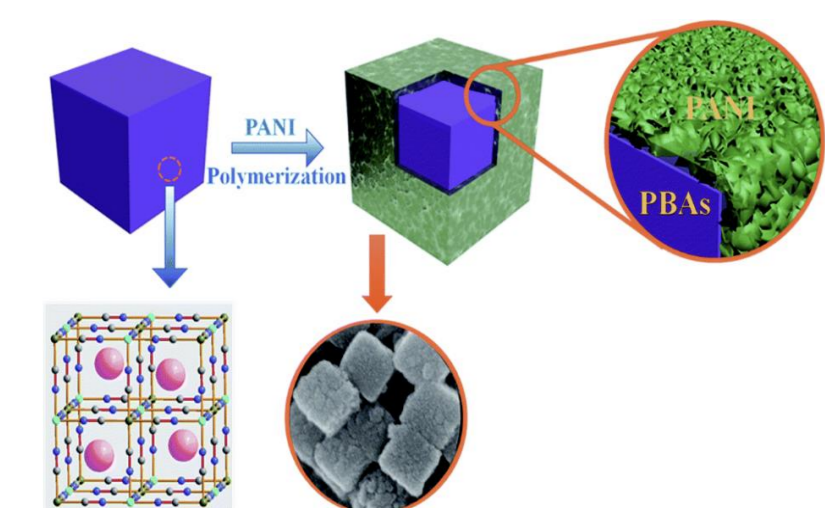
1) Na-Mn-Fe PBA



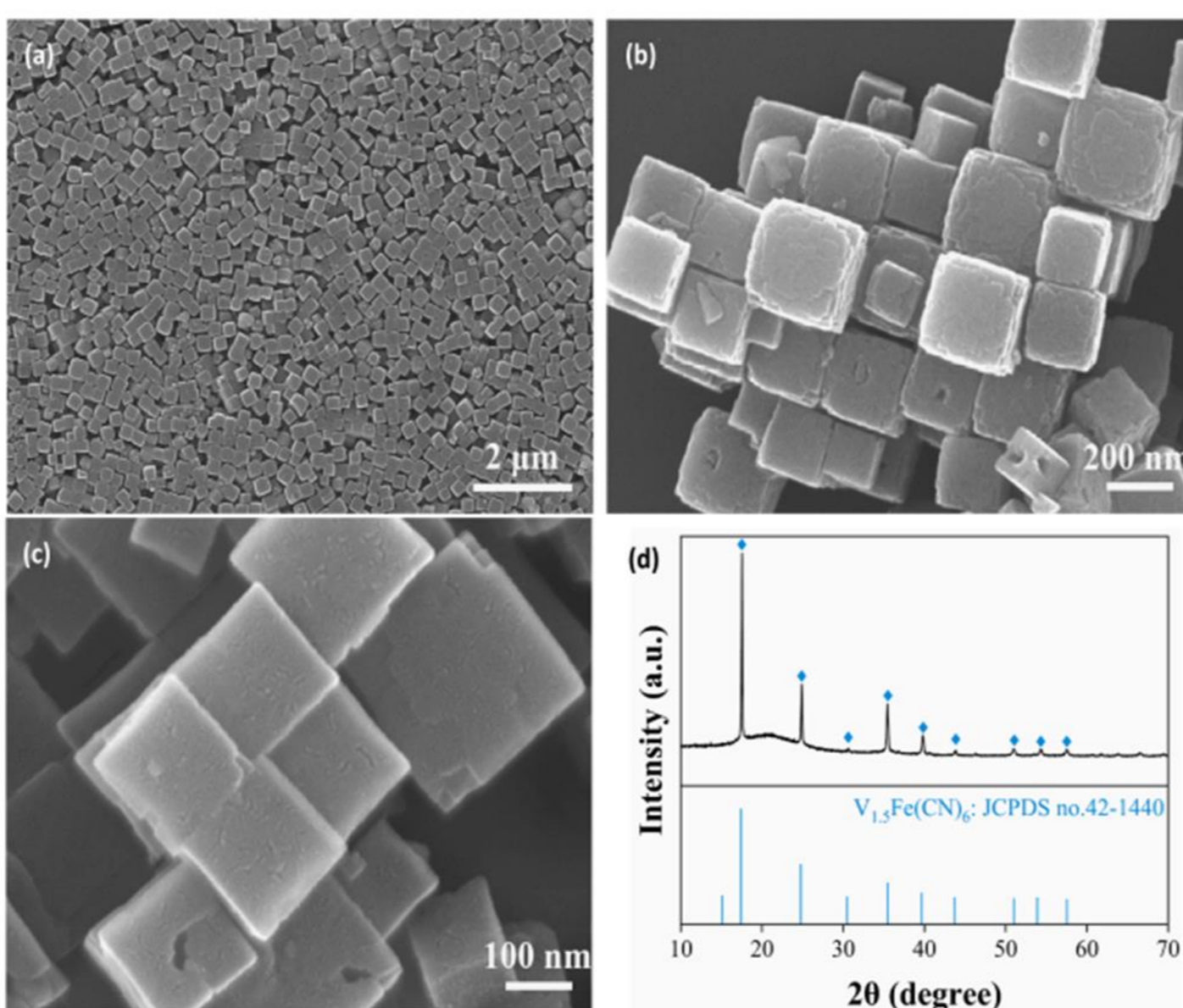
2) PbO2



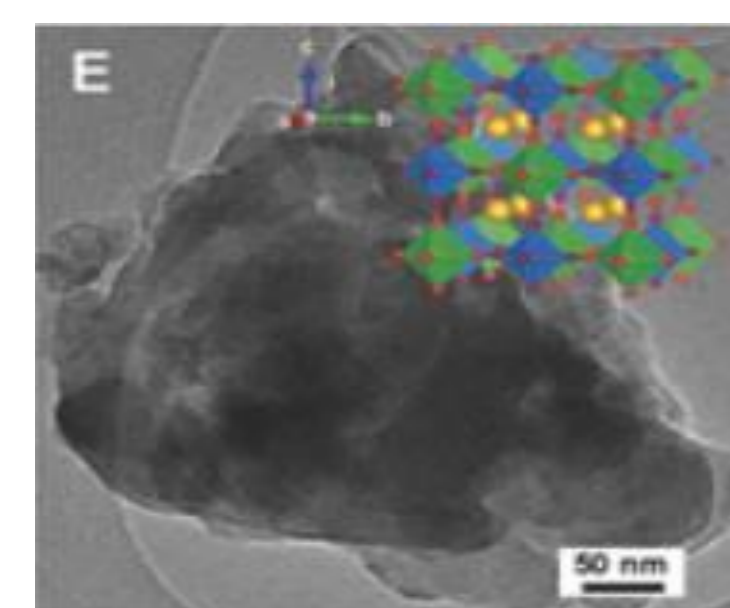
3) PANI + Fe-Co PBA



4) K-V-Fe PBA



5) V/Fe PBA



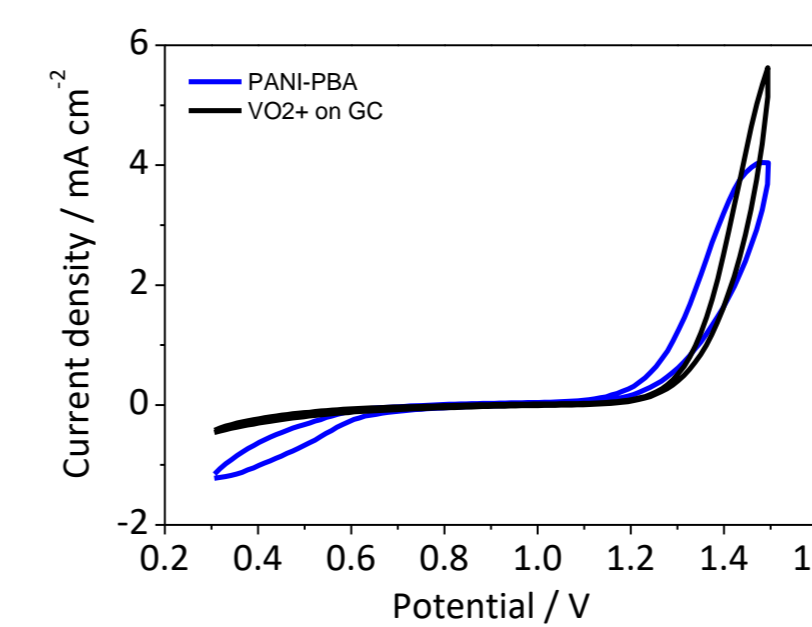
3. Material Selection Criteria and Final Selection Materials

	Na-Mn-Fe PBA	PbO2	PANI+Fe-Co PBA	V/Fe PBA	K-V-Fe PBA
Price of required samples	180,000won	177,100won	47,300won	475,100won	19,800won
synthesis	Easy(1 day)	N/A	Easy(2-3 days)	Easy(2-3 days)	Easy(2 days)
Aqueous electrolyte compatibility	suitable	suitable	suitable	suitable	suitable
Ion radius	suitable	suitable	suitable	suitable	suitable
Metal ion economics	good	bad	good	bad	bad

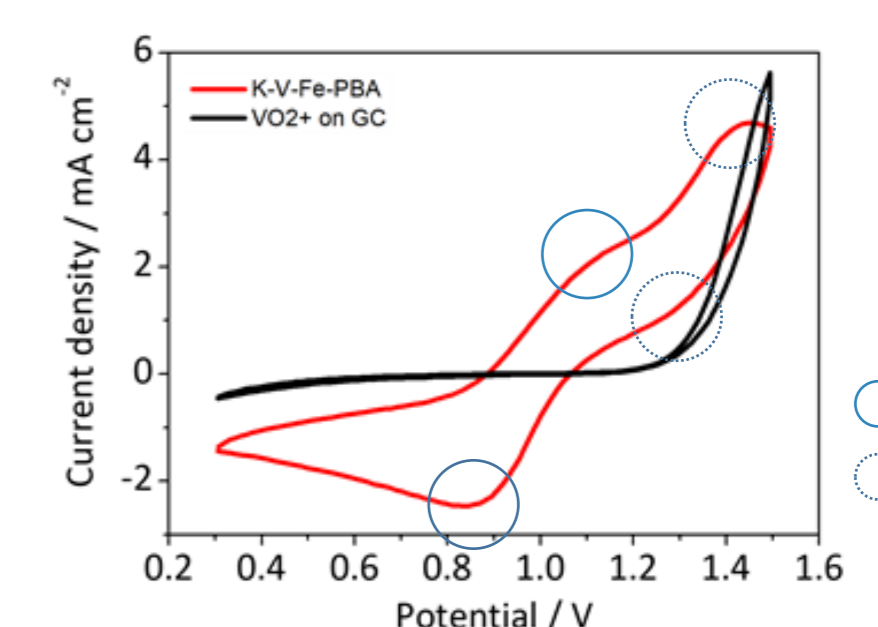
Final Selection Materials

- 1) PANI + Fe-Co PBA and 2) K-V-Fe PBA

4. Result



<PANI+Fe-Co PBA CV data>



<K-V-Fe PBA CV data>

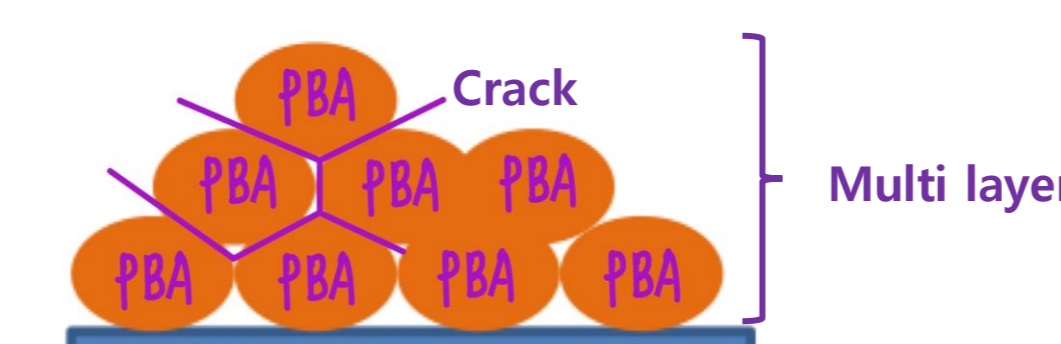
	$\Delta E(V)$	$I_a(mA/A)$	$I_c(mA/A)$	I_{pa}/I_{pc}
PANI+Fe-Co PBA	0.95	0.243	-0.398	0.61
K-V-Fe-PBA	0.34	2.255	-1.293	1.74
Glassy carbon electrode	0.95	0.121	-0.075	1.61

4. DISCUSSION

1) PANI+Fe-Co PBA

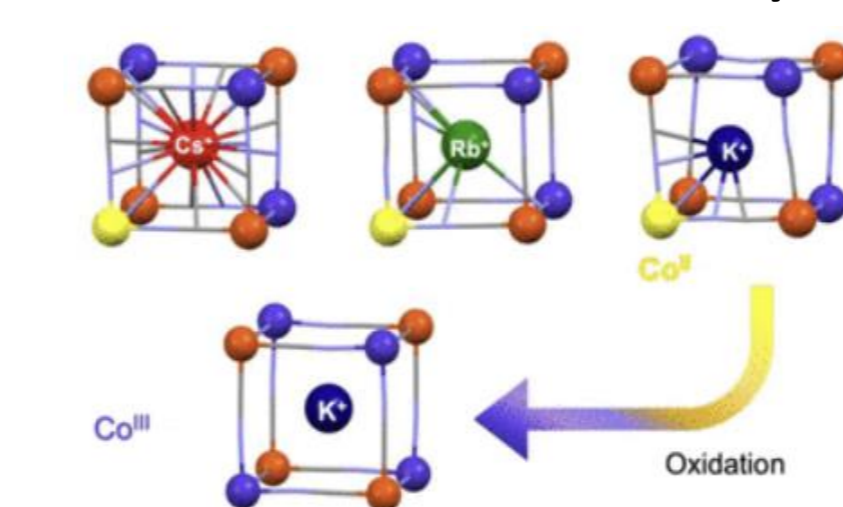
CV of PANI+Fe-Co PBA was not measured. Because sample on electrode dropped by electrolyte.

- Multilayer



Transition metals are corrosive at low pH. Corrosion created a gap in the multilayer above GC electrode, and electrolyte permeated through it, breaking the bonds.

- Lattice distortion by Co



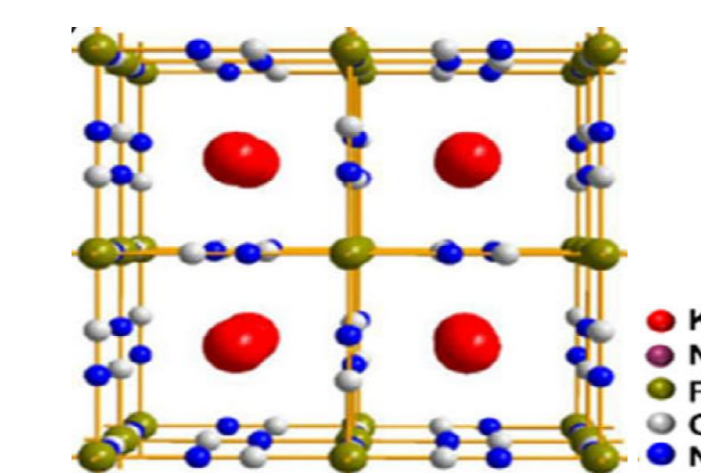
The smaller the size of the cation, the larger the lattice distortion phenomenon. Therefore, there is a possibility that the lattice will break. During the synthesis process, Co^{2+} may exist inside the lattice and it may be distorted by Co^{2+} .

2) K-V-Fe PBA

It was suitable for the RT material.

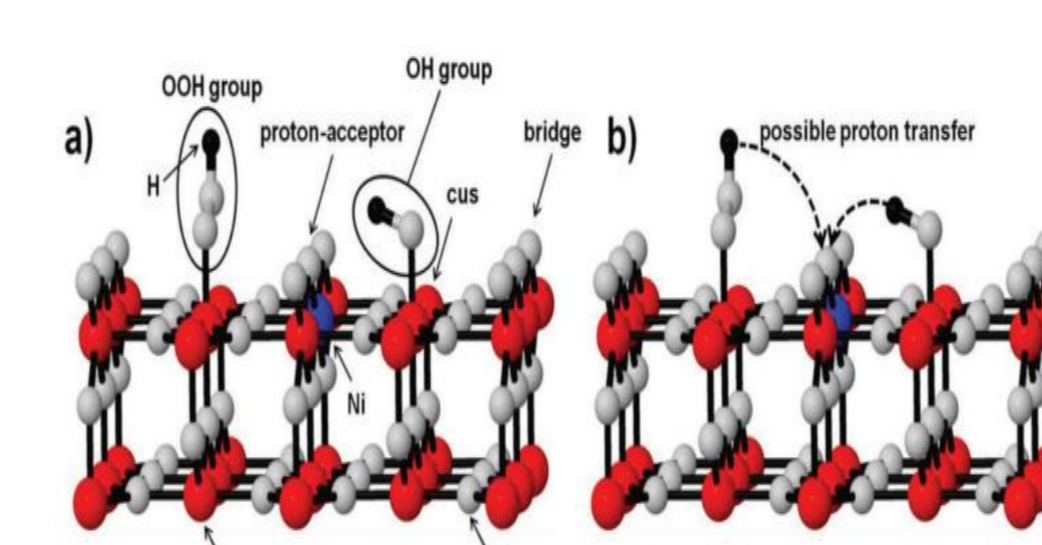
The CV graph showed the peak of the side reaction as well as the main reaction

- Redox of K ion



K^+ has a strong preference for the framework. Thus, it approaches the PBA to lower the lattice deformation and facilitates rapid ion diffusion

- OER(Oxygen evolution reaction) between PBA and electrolyte



PBA has a large amount of catalytic transition metal atoms in a mono polymer framework unit, which promotes OER. In addition, active mass transfer occurs due to the open framework structure of PBA and acts as a catalyst for OER

Conclusions

- PANI+Fe-Co PBA was not suitable for the RT material because sample on electrode dropped by electrolyte. Its reasons are corrosion of multilayer and lattice distortion by Co
- K-V-Fe PBA was suitable for the RT material. And peak of the side reaction was showed. It could be redox of K ion or OER between PBA and electrolyte