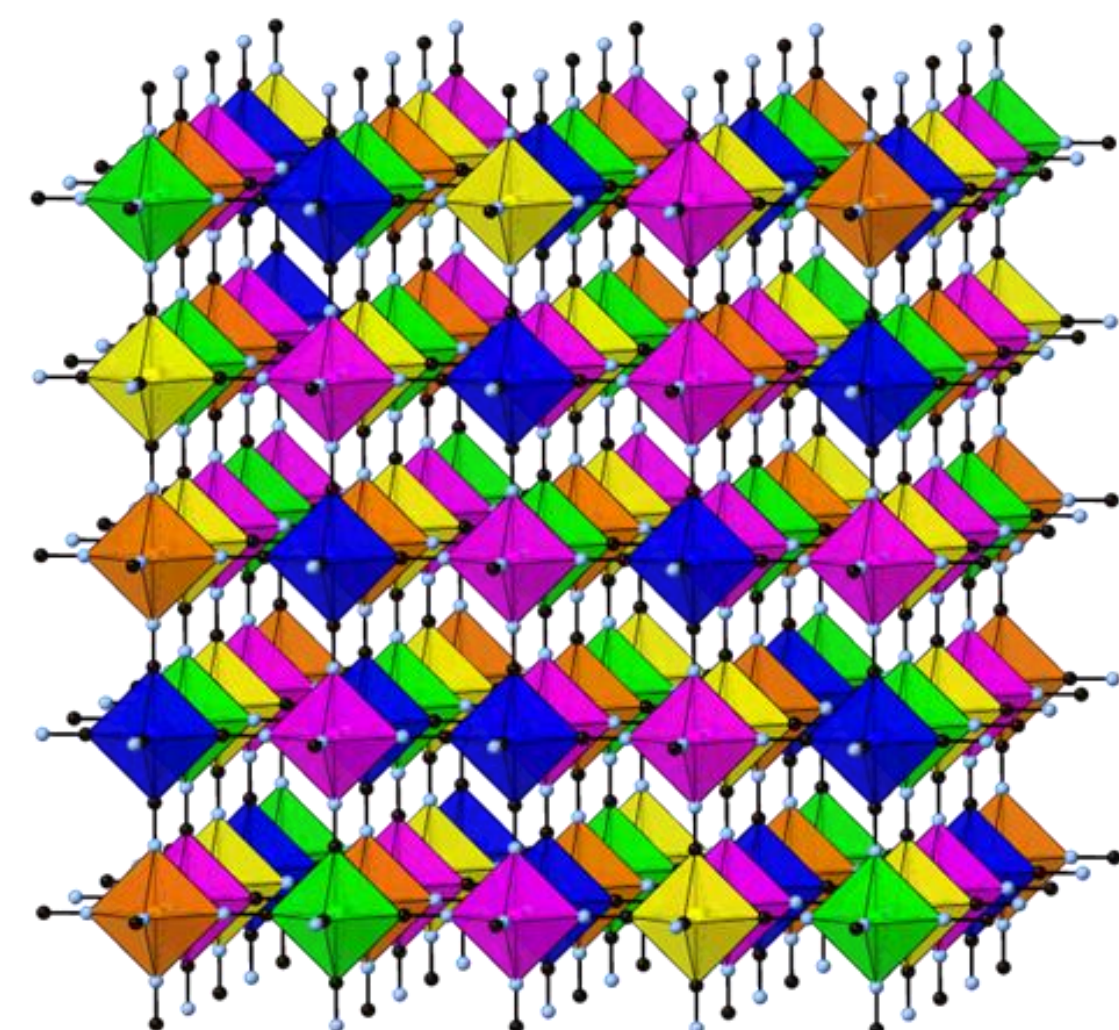
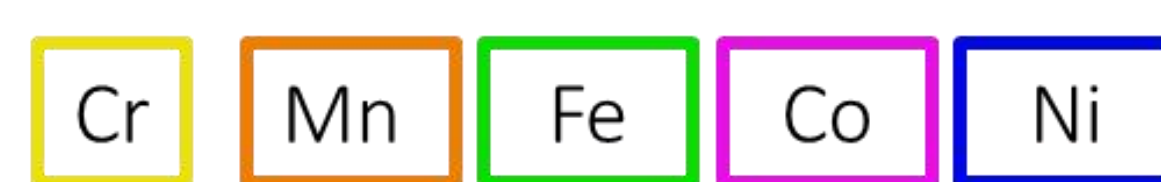


## Introduction

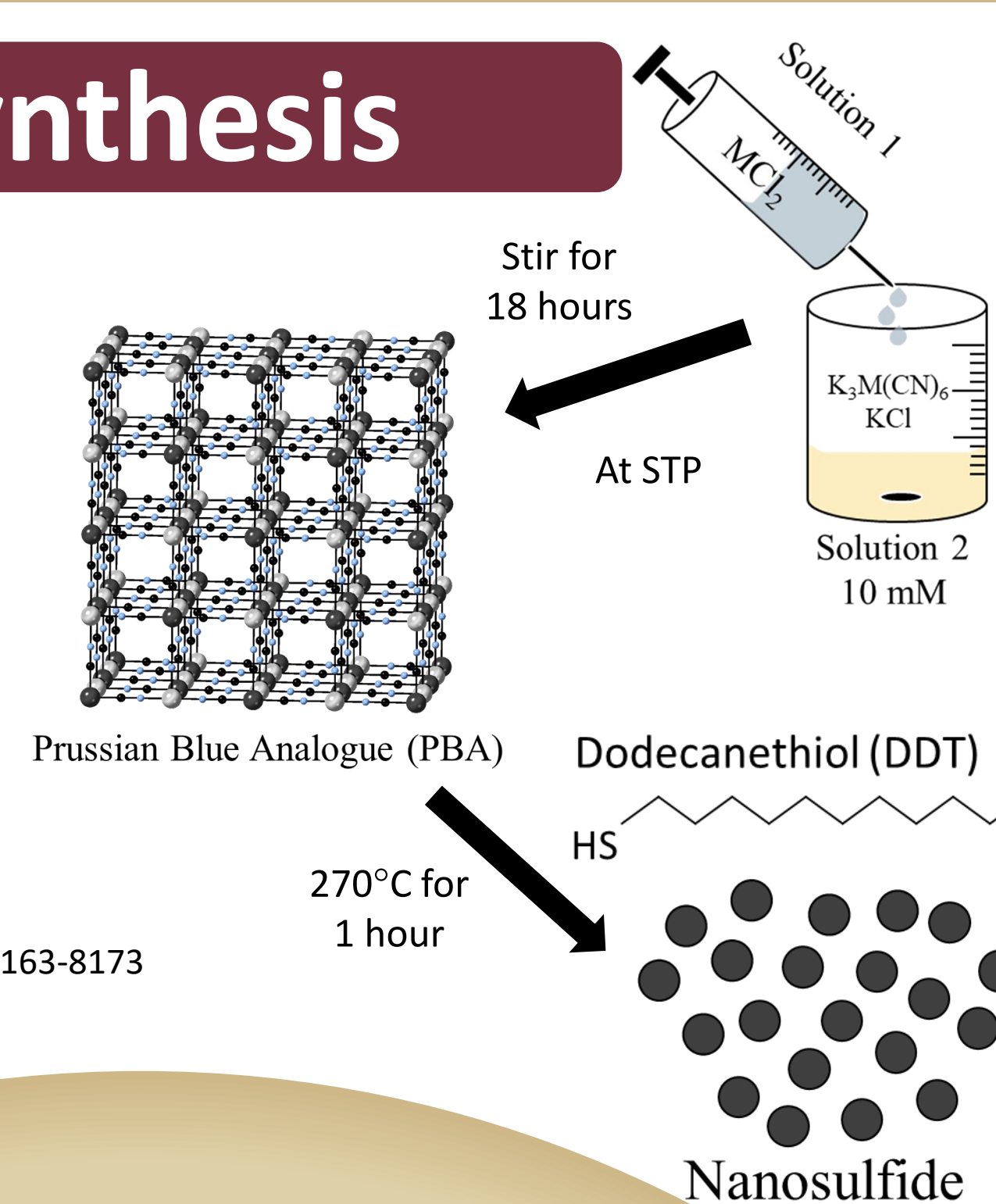
- Nanocrystals** give rise to unique properties that can be used for catalysis.
- High-Entropy Materials** allow for unique chemical behavior and are thermodynamically favorable.
- Prussian Blue Analogues** are highly ordered and structured metal frameworks that can be converted to nanosulfides.



Configurational HEM  
 ✓ Contains > 5 Elements  
 ✓ Equal molar  
 ✓ Ideally Single Phase

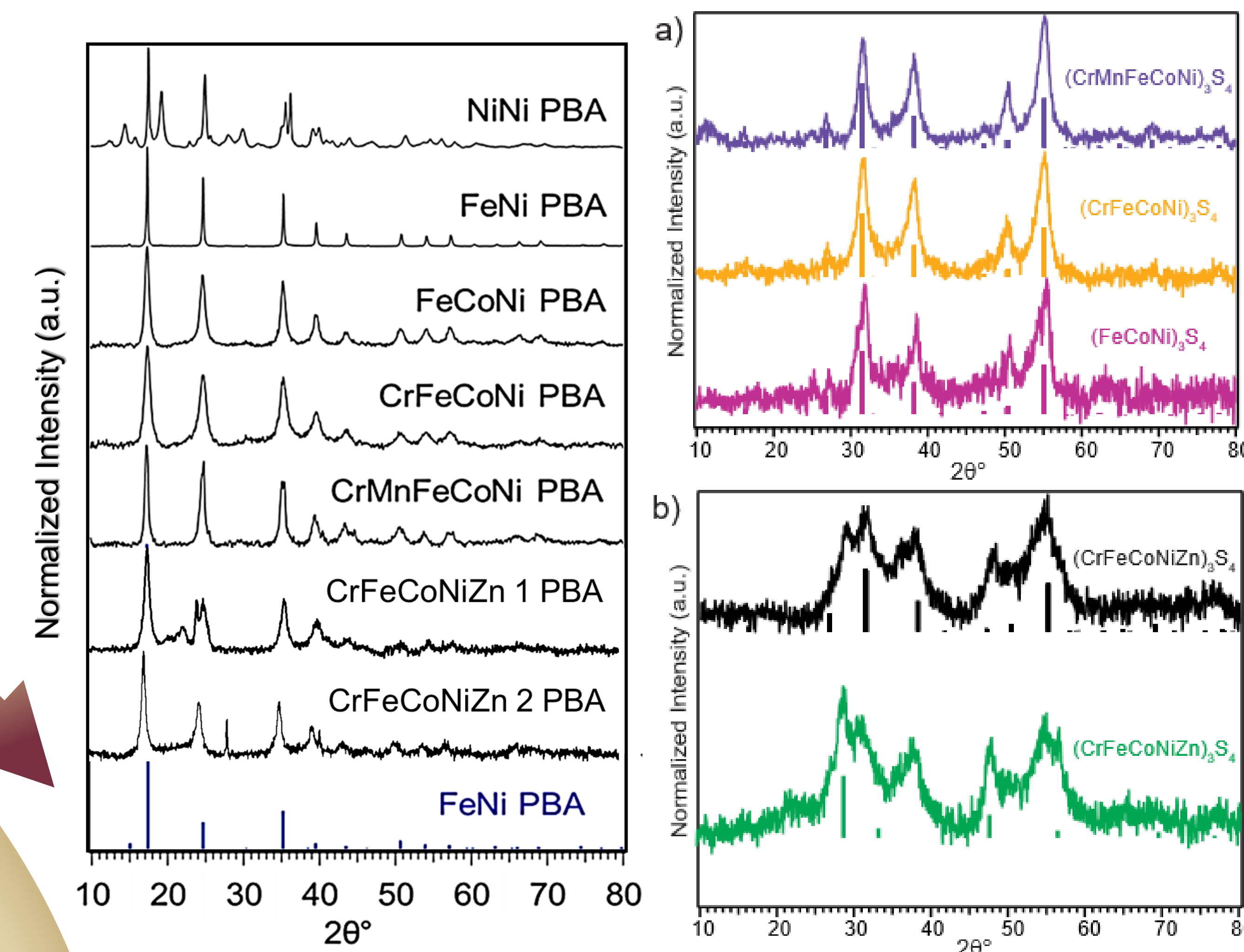
## Synthesis

A solvothermal decomposition reaction of HEM PBA is used to form HEM nanosulfides

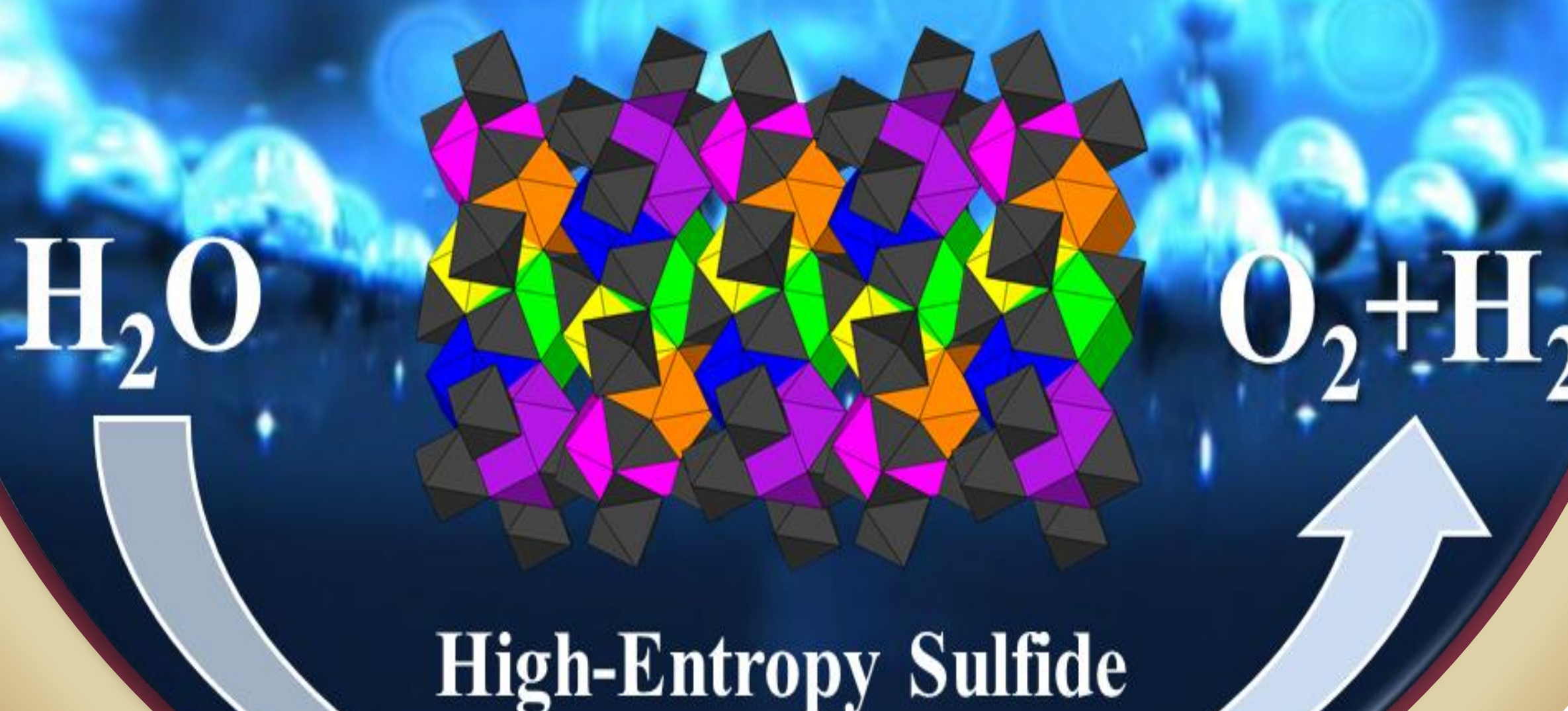


Hardy, et al. *Chem. Materials.*, 2019, 31, 8163-8173

## pXRD



How can **Prussian Blue Analogues (PBAs)** be used to synthesize **High-Entropy Metal Sulfides** with controlled metal ratios and crystal phases for **water-splitting** catalysis?



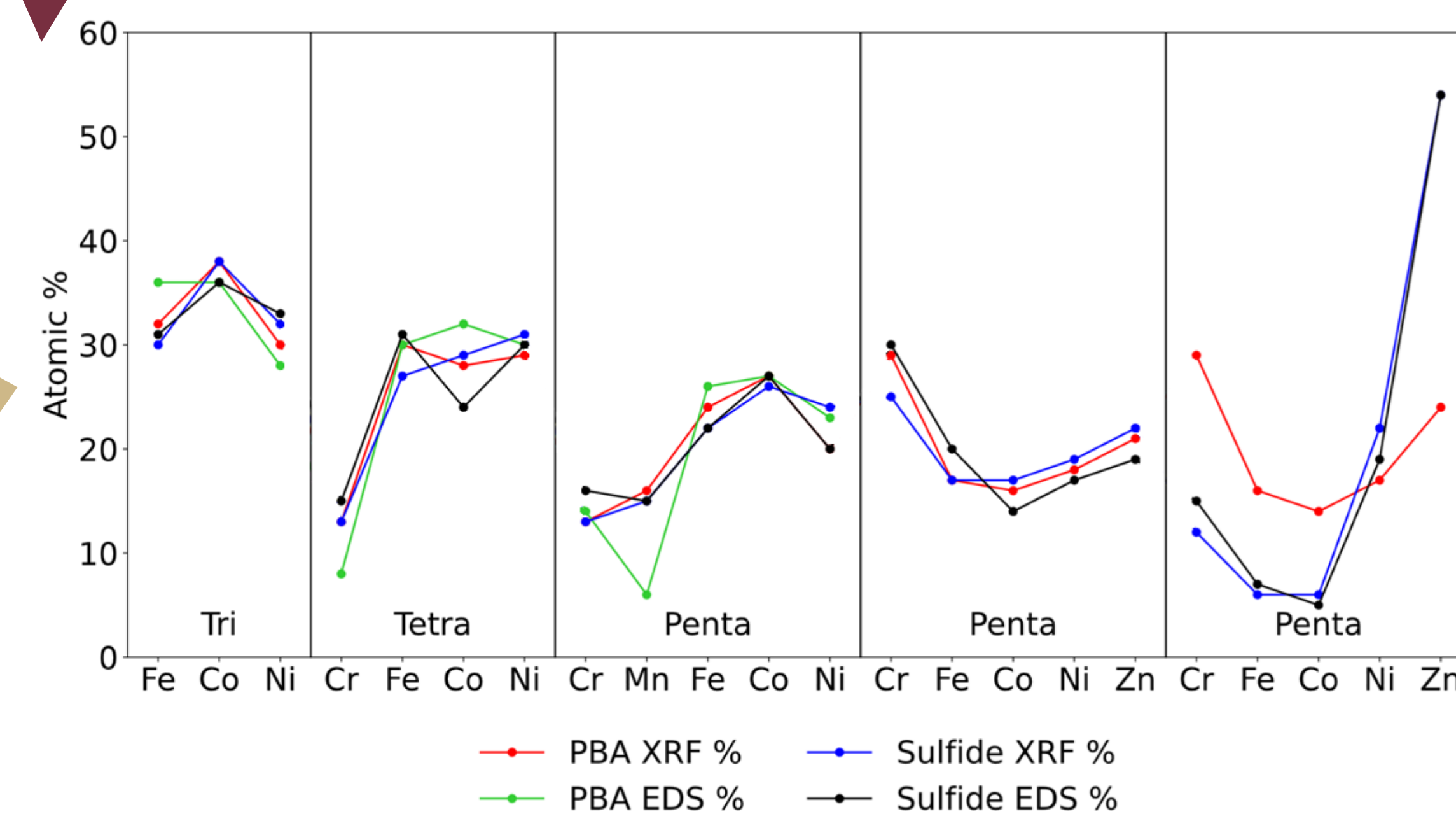
## Conclusions

The **PBA precursors** enable precise control of **metal ratios** and **phase** in multimetallic sulfides. In the **Mn-based systems** form single-phase spinels, while **Zn-based systems** form mixed spinel/sphalerite structures.

Electrocatalyst	OER (η vs RHE)	HER (η vs RHE)
NiS <sub>2</sub>	0.440	-0.597
FeNiS	0.328	-0.234
FeCoNiS	0.469	-0.255
CrFeCoNiS	0.419	-0.292
CrMnFeCoNiS	0.608	-0.329
CrFeCoNiZn S1	0.458	-0.641
CrFeCoNiZn S2	0.502	-0.659

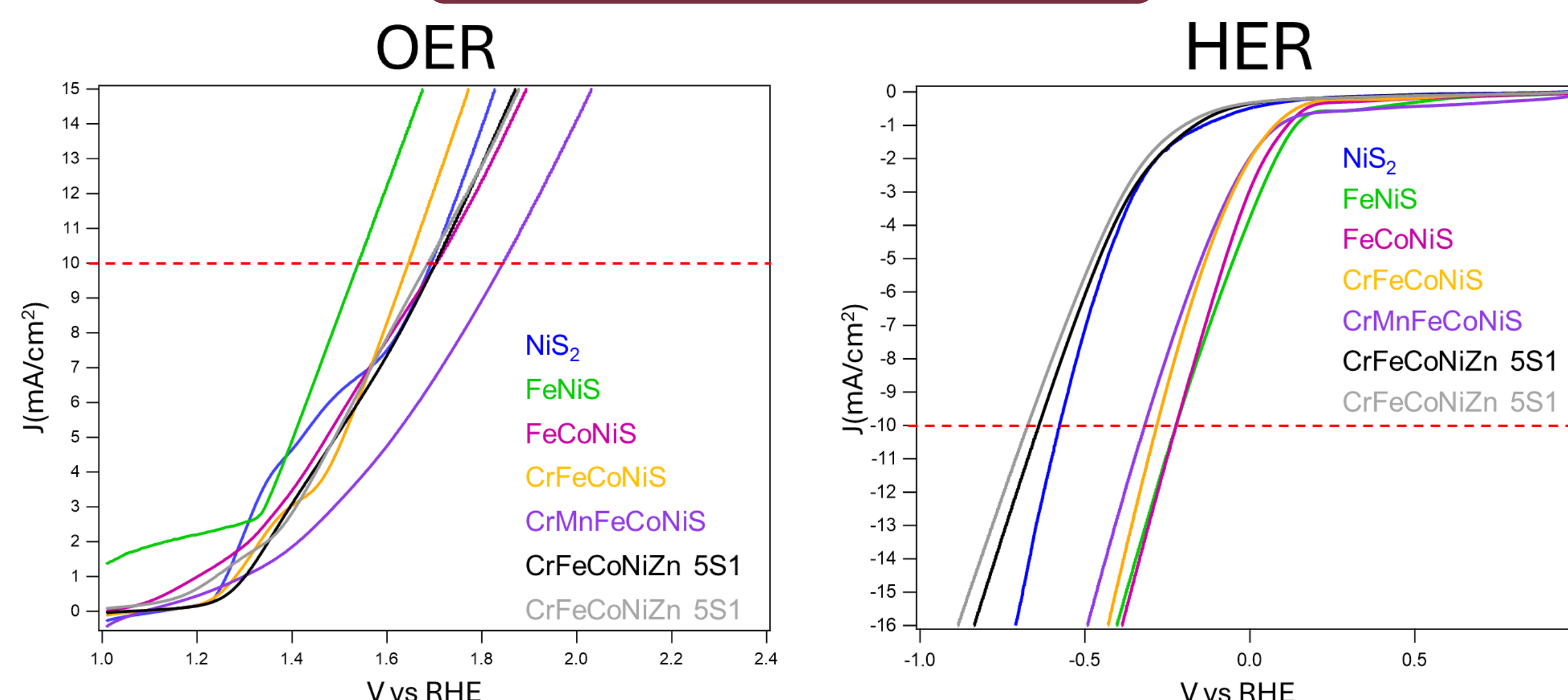
The Trimetallic to Mn-containing Pentametallic: **Single-phase spinel M<sub>2</sub>S<sub>3</sub>**. While the Zn-containing samples: **Mixed Phased of spinel (black) to sphalerite MS (green)**

## XRF/EDS



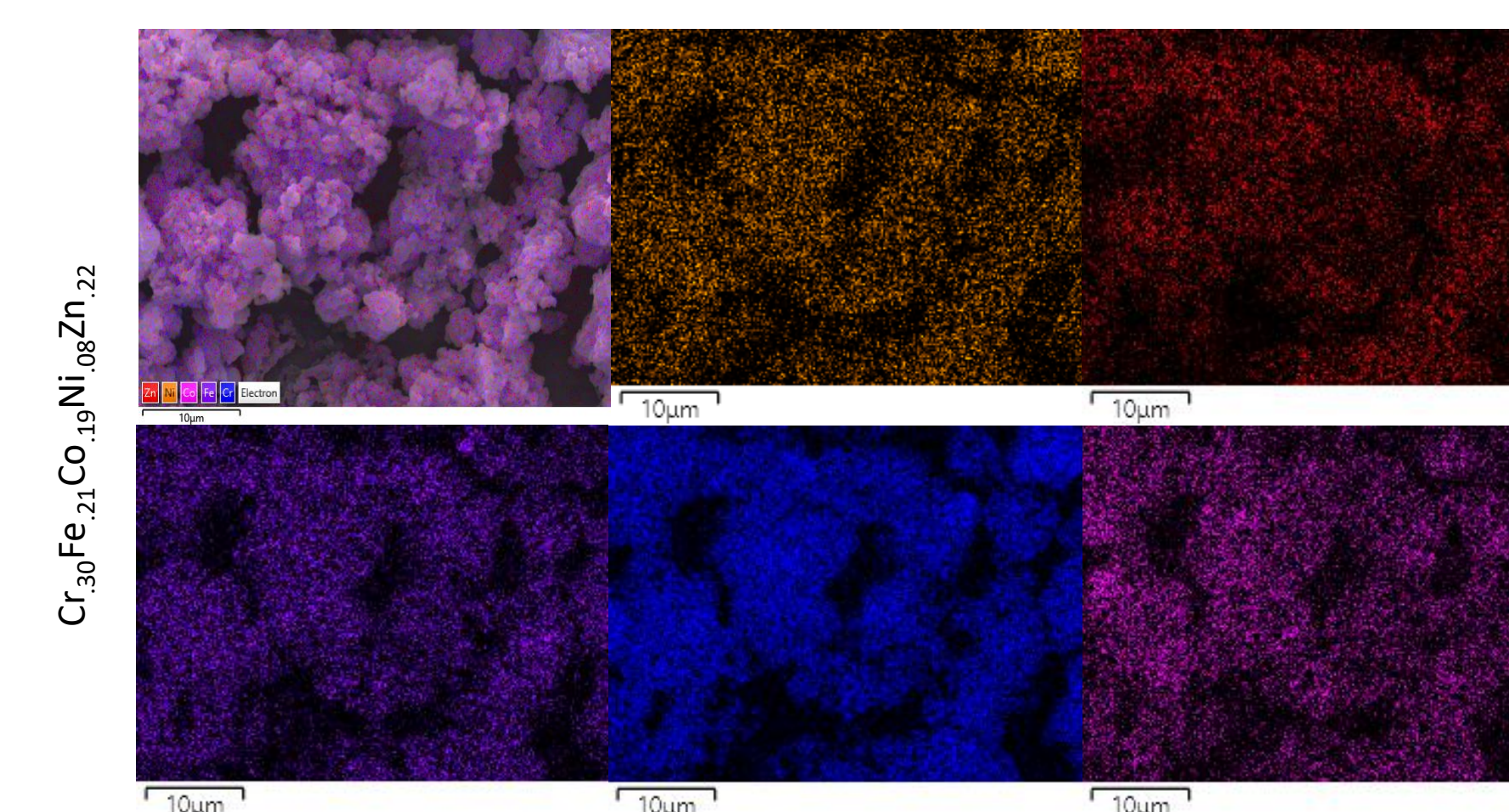
The **Zn-containing materials** deviates from equimolar ratios which caused reduced Cr and Mn content. **Overall XRF and EDS data confirms compositional control.**

## Water-Splitting



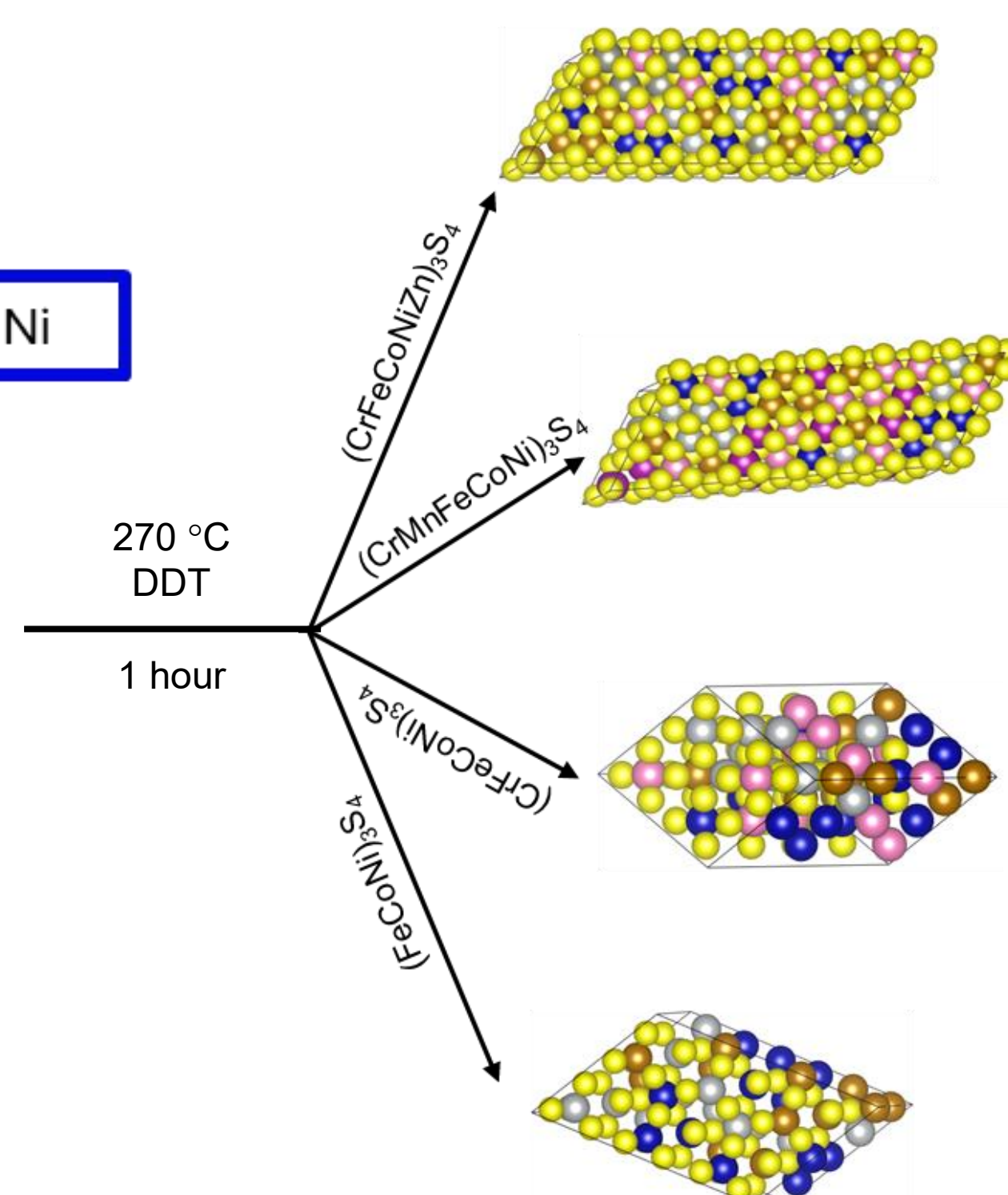
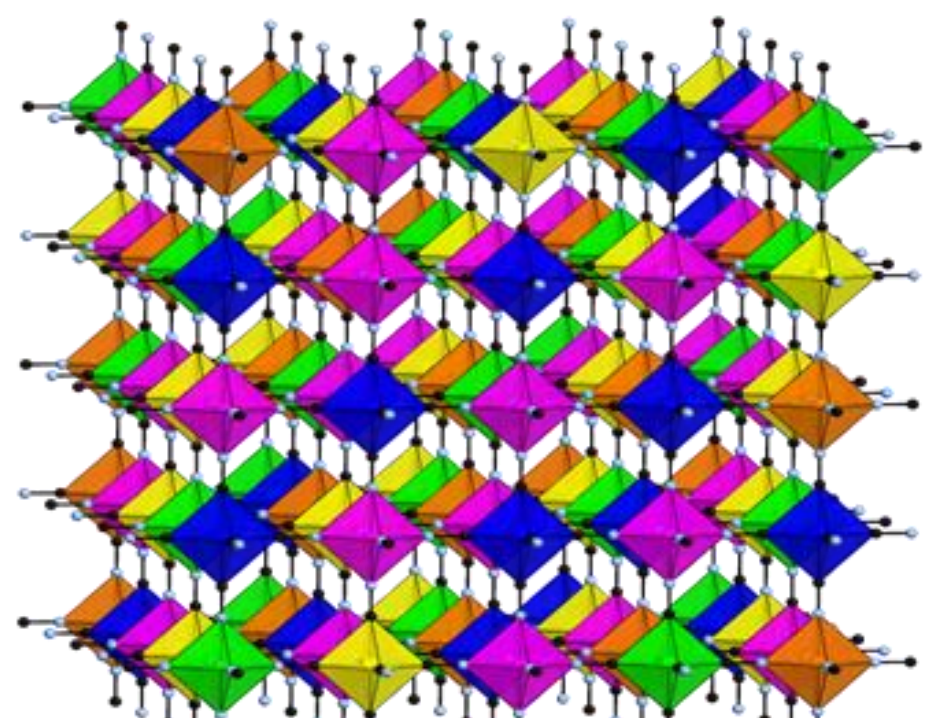
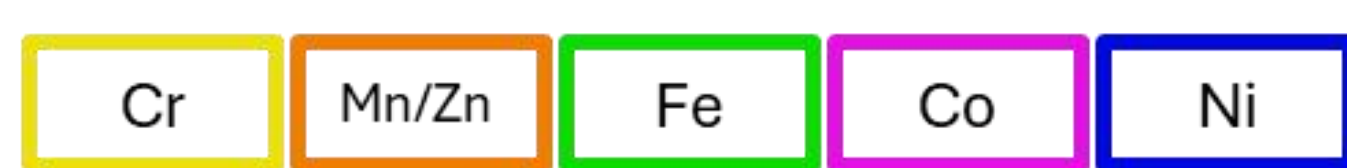
FeNiS (M<sub>2</sub>S<sub>3</sub>) is the best OER and HER catalysis

## SEM/EDS



The EDS shows **homogenous incorporation** across the 5 metals. Size inversely proportional to metal amount.

## PBA



**Future Directions** include **tune metal ratios** and add halides to optimize phase stability and catalytic response.

