Water Splitting by Transition Metal Mixed Anionic Chalcogenides

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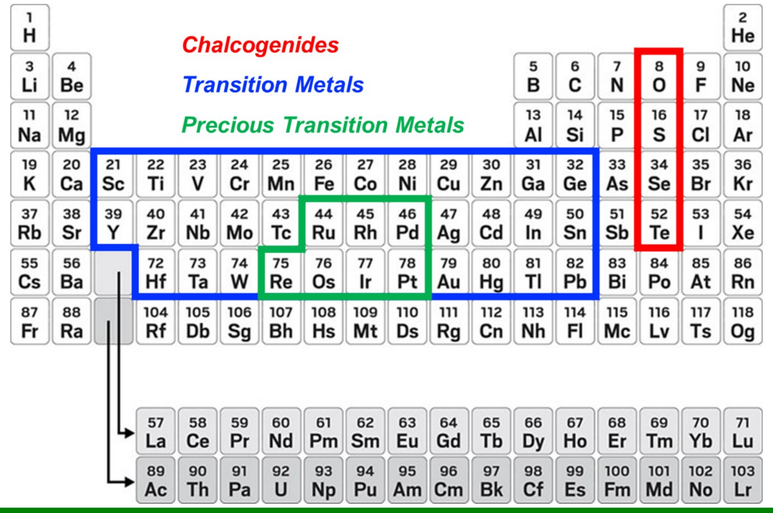
INTRODUCTION

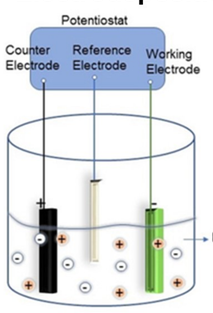
Over the past few decades, research interest in materials design and synthesis, as well as applications channeled towards sustainable energy generation and storage from renewable sources, has increased tremendously due to the continuing depletion of fossil fuels. Among these, water splitting, capable of generating clean hydrogen fuel on-demand has attracted considerable interest due to its wide range of applicability in various technologies including fuel cells, solar-to-fuel energy conversion, and water electrolyzers.



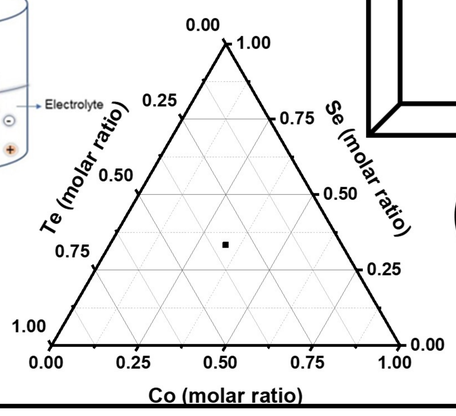
METHODS

Cobalt telluro-selenide ($Co_xTe_ySe_z$)

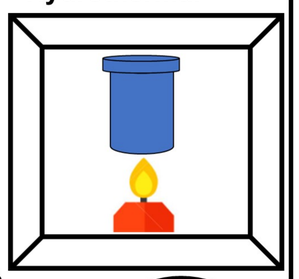
Electrodeposition



Co precursor
SeO_2
TeO_2
80° C



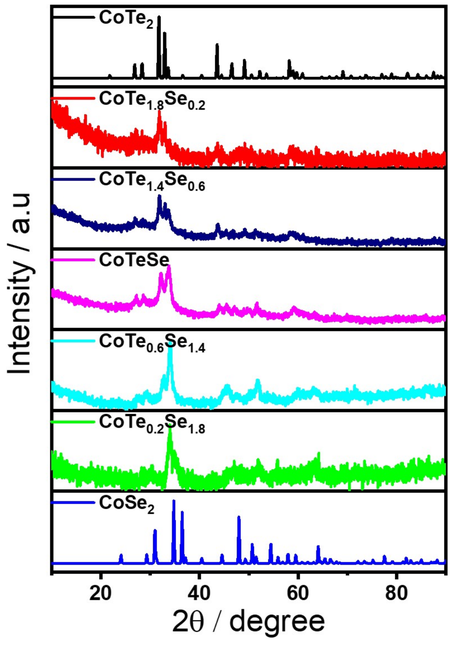
Hydrothermal



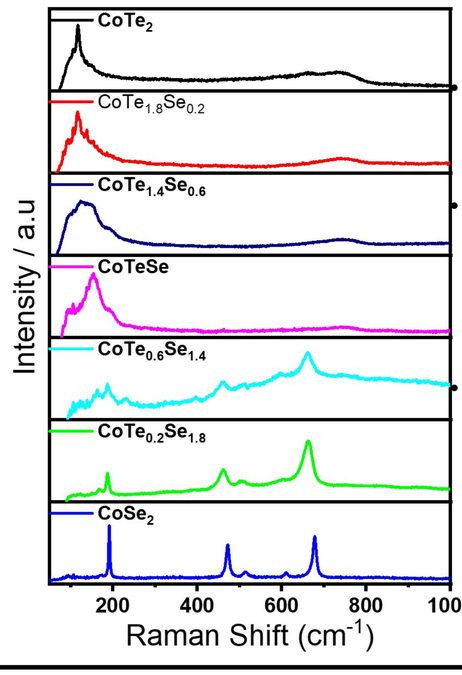
Co precursor
SeO_2
TeO_2
Reducing agent
150-185° C

RESULTS

X-Ray Diffraction (XRD) and Raman spectroscopy for cobalt mixed anionic chalcogenide series



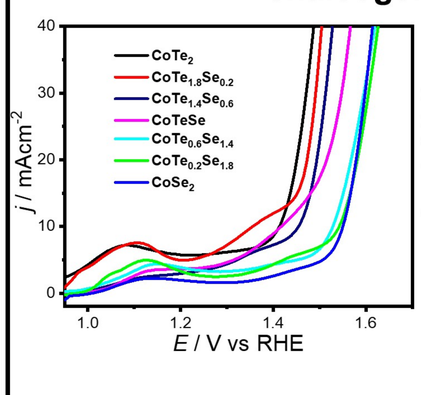
- Pattern like parent $CoTe_2$ with Se incorporation, until $CoTe_{1.4}Se_{0.6}$
- $CoTe_2$ and $CoSe_2$ patterns match well with their respective standard pattern
- CoTeSe and $CoTe_{0.6}Se_{1.4}$ compositions give patterns different from the parents $CoTe_2$ and $CoSe_2$.

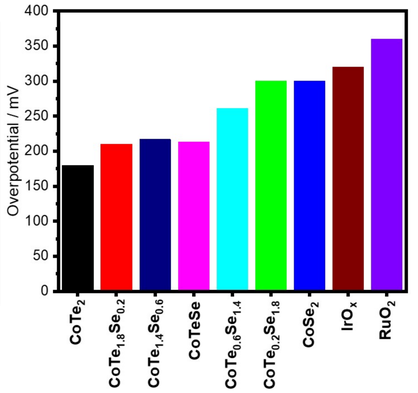


- The peak at 129 cm^{-1} corresponds to A_{1g} in orthorhombic $CoTe_2$
- The peaks of $CoSe_2$ located at 188 cm^{-1} and 670 cm^{-1} corresponds to A_{1g} and A_{1u} mode of orthorhombic $CoSe_2$
- The peaks at 470 cm^{-1}, 509 cm^{-1} and 609 cm^{-1} are consistent with the E_g, $F^1{}_{2g}$ and $F^1{}_{2g}$.

RESULTS

Catalytic activity towards OER and overpotentials for cobalt mixed anionic chalcogenide series





CONCLUSION

- Cobalt mixed anionic chalcogenide series was successfully synthesized by hydrothermal method and tested for water splitting.
- Their activities towards OER were found to higher than that of the parent cobalt selenide ($CoSe_2$) and lower than the parent cobalt telluride ($CoTe_2$).
- Could help in understanding the role of mixed anions in the activity and a prediction of OER activity in a transitional metal anionic series.

ACKNOWLEDGMENTS

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OURE Department

REFERENCES

1. Jahangir Masud, et. al., *ACS Appl. Energy Mater.* 2018, 1, 8, 4075–4083
2. Umanga De Silva; et. al., *J. Mater. Chem. A*, **2018**, 6, 7608-7622
3. Xi Cao, Yu Hong; et. al., *ACS Catal.*, **2018**, 8, 9, 8273–8289
4. Yongchao Tang; et. al., *J. Mater. Chem. A*, 2017, **5**, 13591-13600