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Ge-based intermetallic compounds as materials for catalysts in an electrochemical nitrite reduction reaction

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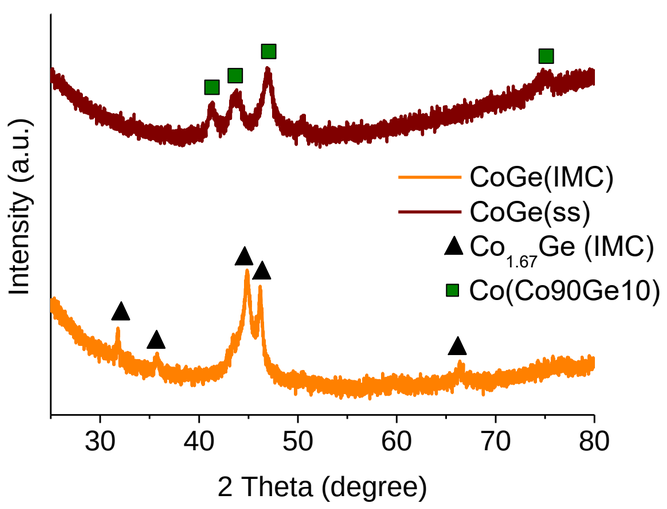
INTRODUCTION & AIM

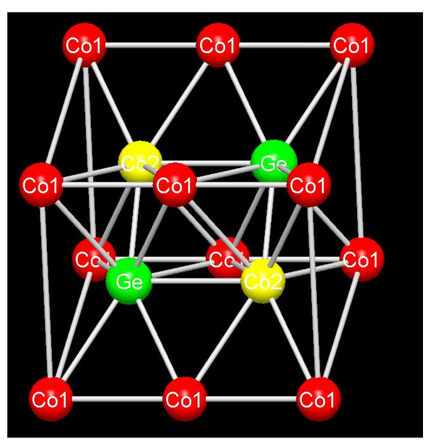
An important reaction contributing to the development of hydrogen energy and the potential replacement of the Haber–Bosch industrial process for ammonia synthesis is the electrocatalytic nitrogen reduction reaction, as well as the key reactions for optimizing this latter reaction: electrocatalytic nitrate and nitrite reduction reactions. Due to nitrate contamination of agricultural and industrial wastewater, nitrite contamination can be more dangerous due to the greater toxicity of the nitrite ion. Thus, the search for efficient and low-cost catalysts based on non-precious metals and their compositions is currently crucial. In turn, intermetallic compounds (IMCs) are currently poorly studied for this purpose and, at the same time, are in demand, since their catalytic efficiency can potentially approach single atomic catalysts (SACs).

The aim of our study is to synthesize IMCs based on Ge and transition metals and test catalysts based on this in the electrochemical nitrite reduction reaction (NO_2^-RR).

METHOD

Results of X-ray for Ge-IMC





$Co_{1.67}Ge$

- The heat treatment time at 800 °C was 150 hours
- The arc melting in argon atmosphere

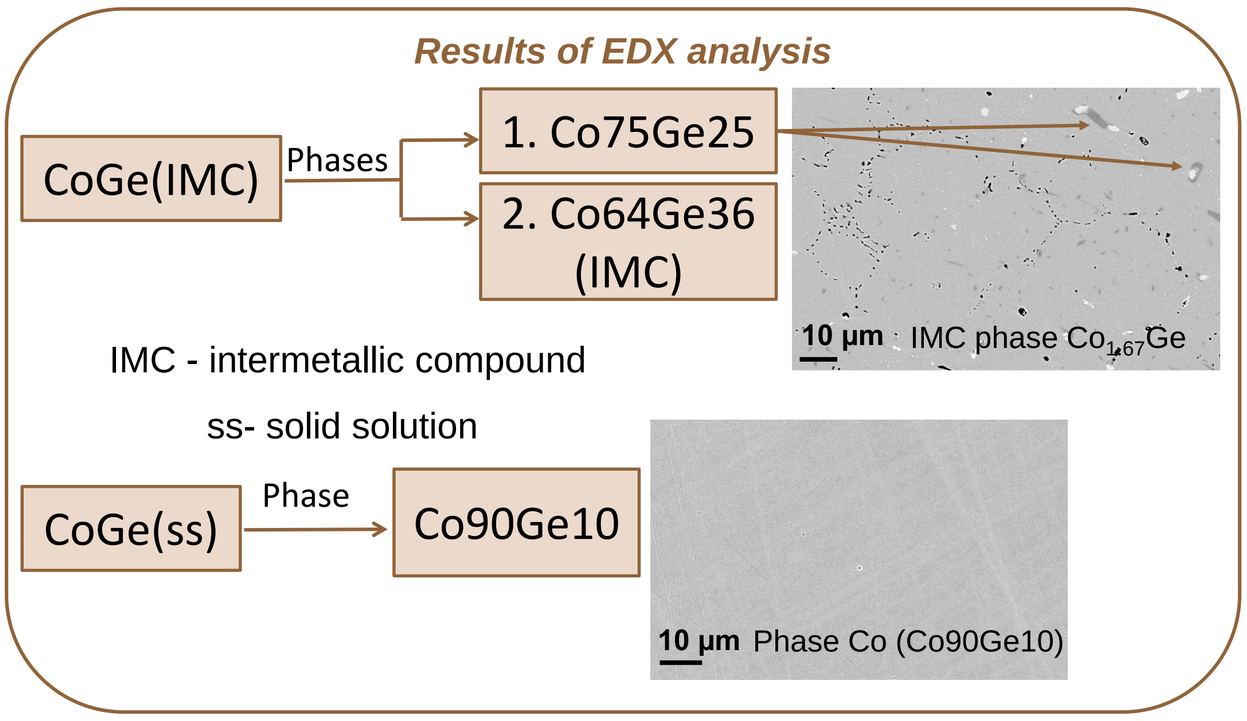
Faradaic efficiency

- $n(NH_3)$ denotes the amount (mol) of NH_3
- F is the Faradaic constant (96,485 C mol^{-1})
- Q is the total charge passed through the electrode
- 8 is the number of electron (n) transfers required to form 1 mol of ammonia

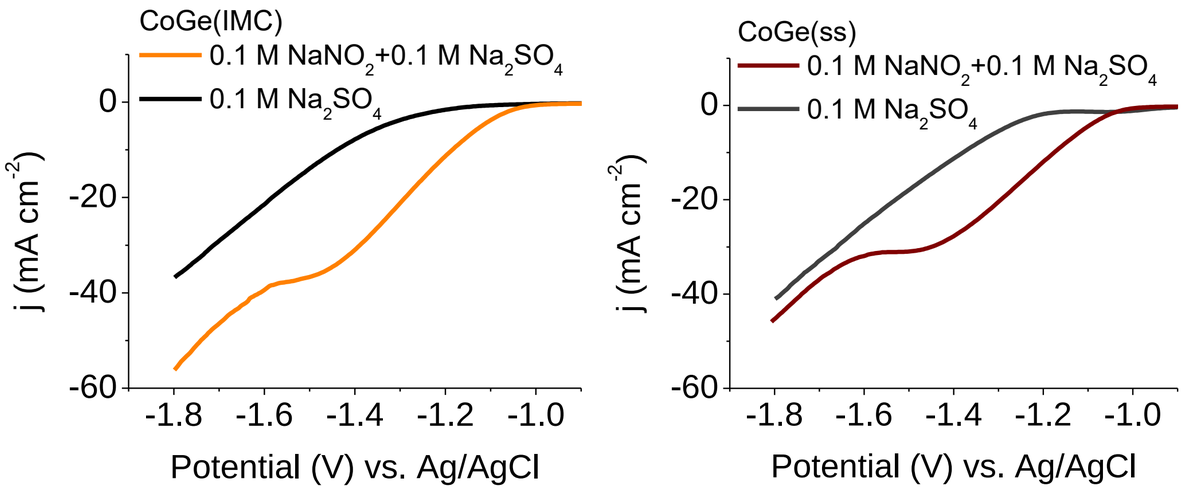
$$FE(NH_3) = \frac{8 \times F \times n(NH_3)}{Q}$$

RESULTS & DISCUSSION

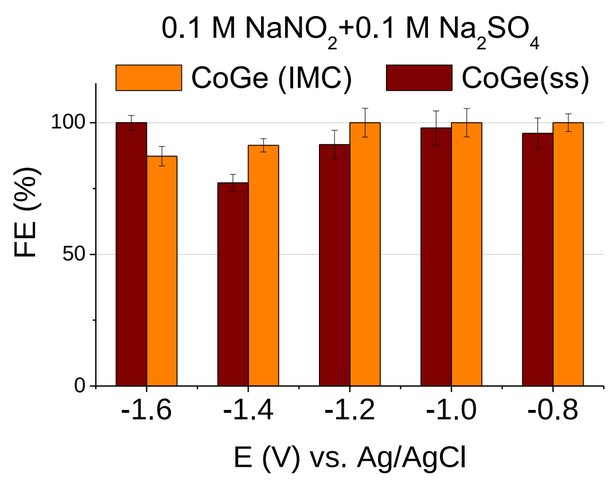
Results of EDX analysis

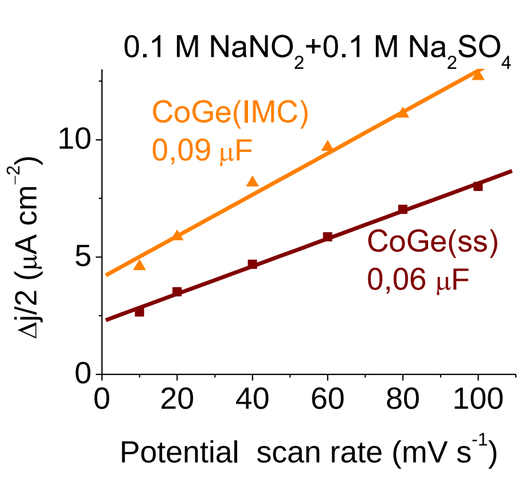


LVs results



Faradaic efficiency results and electrochemical surface area (ECSA)





CONCLUSION

The results show that the use of Ge electrocatalysts is promising, since excellent values of Faradaic efficiency (FE) and ammonia yield rate were achieved in the NO_2^-RR . Moreover, IMC-based catalysts showed good results at significantly lower potentials than solid solution catalysts.

FUTURE WORK / REFERENCES

Acknowledgments:

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