



Highly Efficient Protection Of Heat Exchanger-type Cu-Ni Alloy Against Acid Corrosion Using a Benzotriazole + KI mixture

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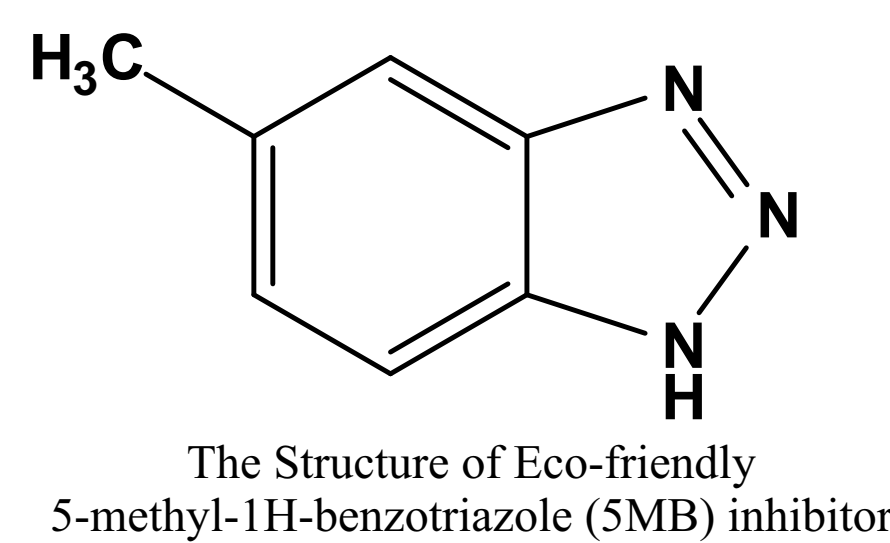
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Introduction

- The rapidly growing human population faces a crucial challenge of freshwater availability making sea water desalination a promising technology.
- Heat exchanger units (usually made up of Cu-Ni alloy) in desalination plants loses its structural integrity overtime due to inorganic salts clogging their internal walls
- Acid Cleaning (pickling) is most effective to remedy this menace. However, this causes corrosion of the underlying alloys.
- The addition of highly-efficient and low toxic corrosion inhibitors to the acid cleaning solutions helps to mitigate corrosion of heat exchanger walls.

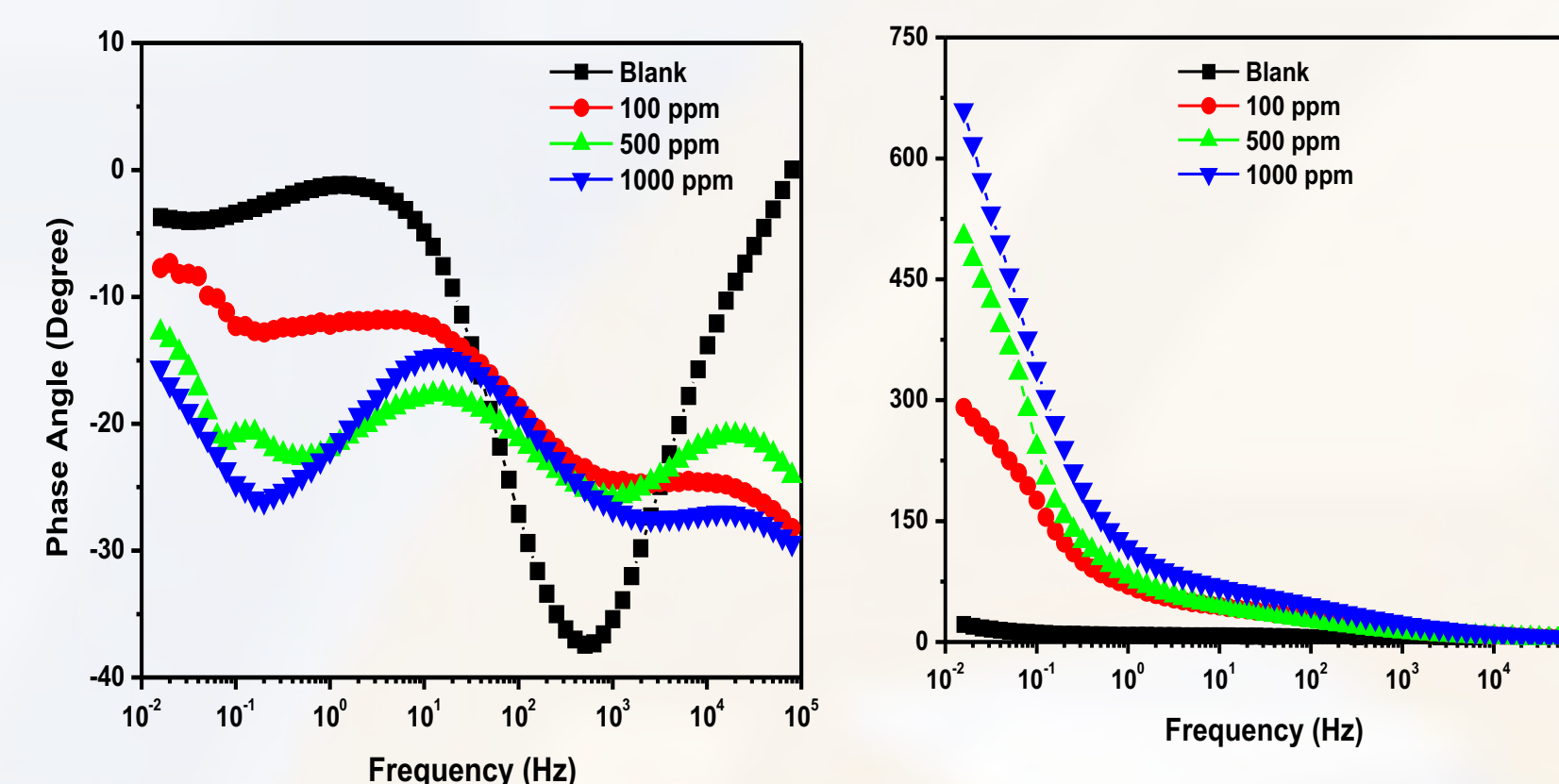


Methodology

- Preparation of Cu-Ni Alloy for analysis
- Preparation of study solution
- Immersion of prepared Cu-Ni alloy in study solution
- Corrosion Studies; Open circuit, EIS and PDP
- Electronic property study; Mott-Schottky analysis

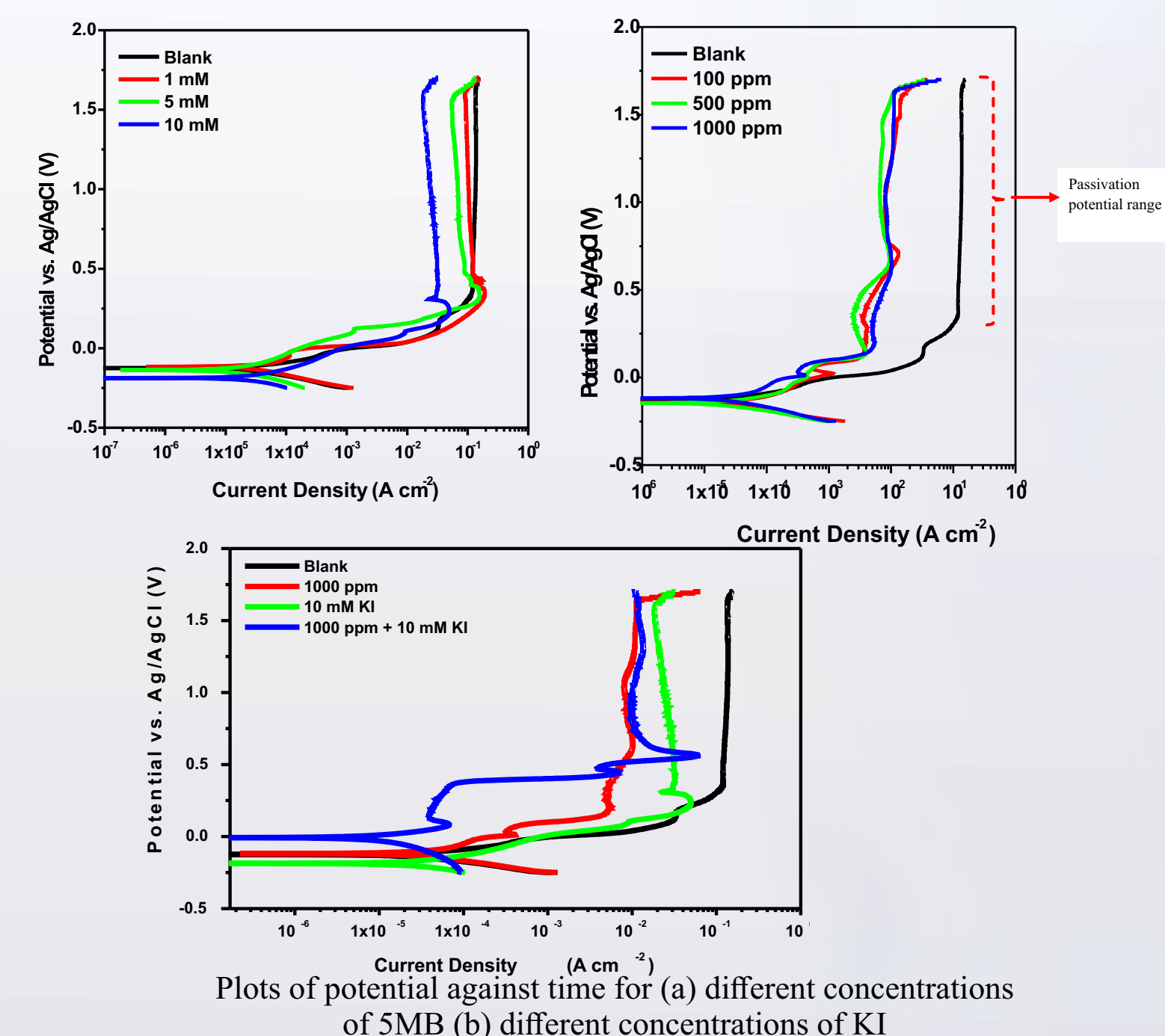
Results

Electrochemical impedance spectroscopy

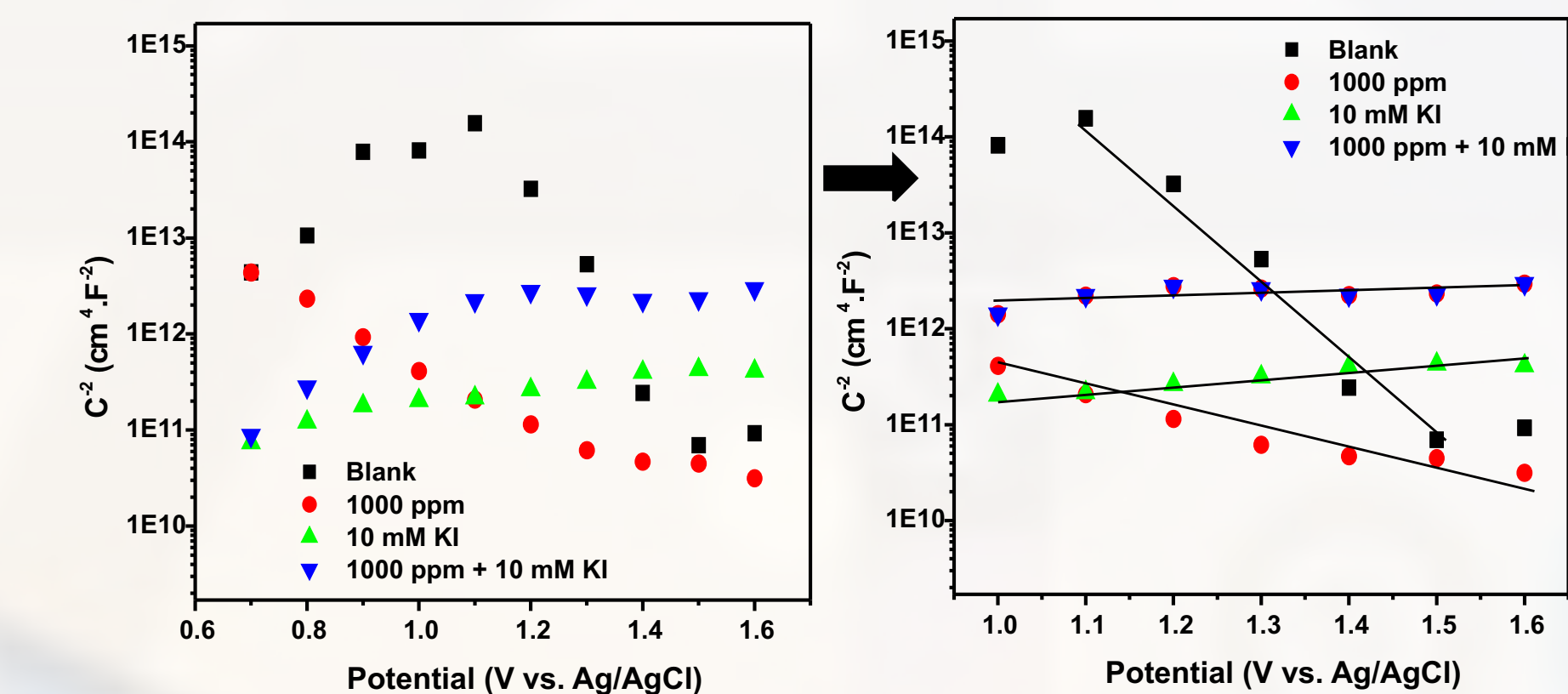


Bode plot (phase angle against frequency) for different conc. Of 5MB

Potentiodynamic Polarization Study



Mott Schottky Analysis



Mott-Schottky plots for passivated Cu-Ni 70/30 without and with 1000ppm 5MB, 10mM KI and 1000ppm + 10 mM KI

A transformed plot with line of best fit indicating semi-conductor properties

Discussion

- An average inhibition efficiency of 72% was achieved by the maximum concentration of 5MB (1000ppm) which increased to 93% by adding 10mM KI.
- 5MB + KI mixture shifted corrosion potential (E_{corr}) more anodically and boosted the passivation of Cu-Ni based on PDP analysis.
- According to EIS Measurement, Passive Layer became adherent, compact and efficiently hydrophobic.
- From Mott-Schottky analysis, the passive layer exhibited a p-type semi-conductor property on addition of 5MB but transformed to an n-type semi-conductor for a mixture of 5MB + KI.

Conclusion

- Cu-Ni 70/30 alloys formed passivated films.
- These films were seen to be enhanced in the presence of 5MB at different concentrations.
- The ability of the passivated films to resist corrosion increased with increase in concentration. 1000 ppm being the optimum concentration.
- Synergistic effect was studied with KI. 10 mM KI was seen to have a better synergistic effect than 1 mM and 5 mM KI.
- The passivated films was a p-type semiconductor which changed to an n-type semiconductor in the presence of 10 mM KI.

Objectives

- Ascertain the existence and effect of passive film formation, corrosion resistance property and electronic property of Cu-Ni (70/30) alloy.
- Know the corrosion inhibition performance of novel eco-friendly inhibitor (5MB) in the acid cleaning of Cu-Ni alloy.
- Use the Mott Schottky analysis to determine the type of semi-conductor the Cu-Ni Passive film will be in the presence of 5MB.

References

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