

DTU





GREEN CORROSION INHIBITORS FOR CORROSION PREVENTION OF CARBON STEEL UNDER CO₂ CONDITIONS

A new approach for environmentally friendly corrosion inhibition of steel
in the oil and gas industry

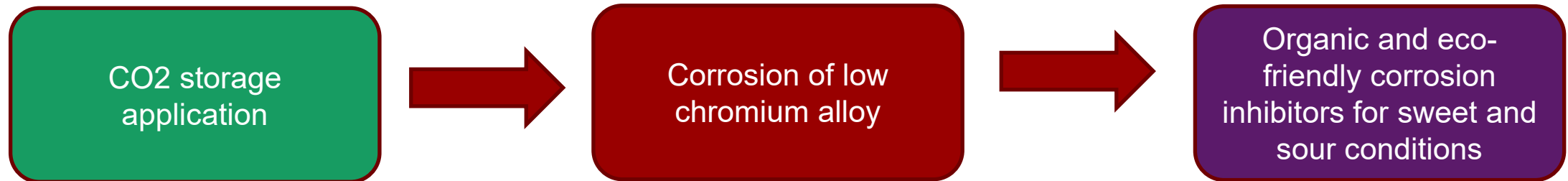
DTU Offshore

PhD. Ghada Shaban

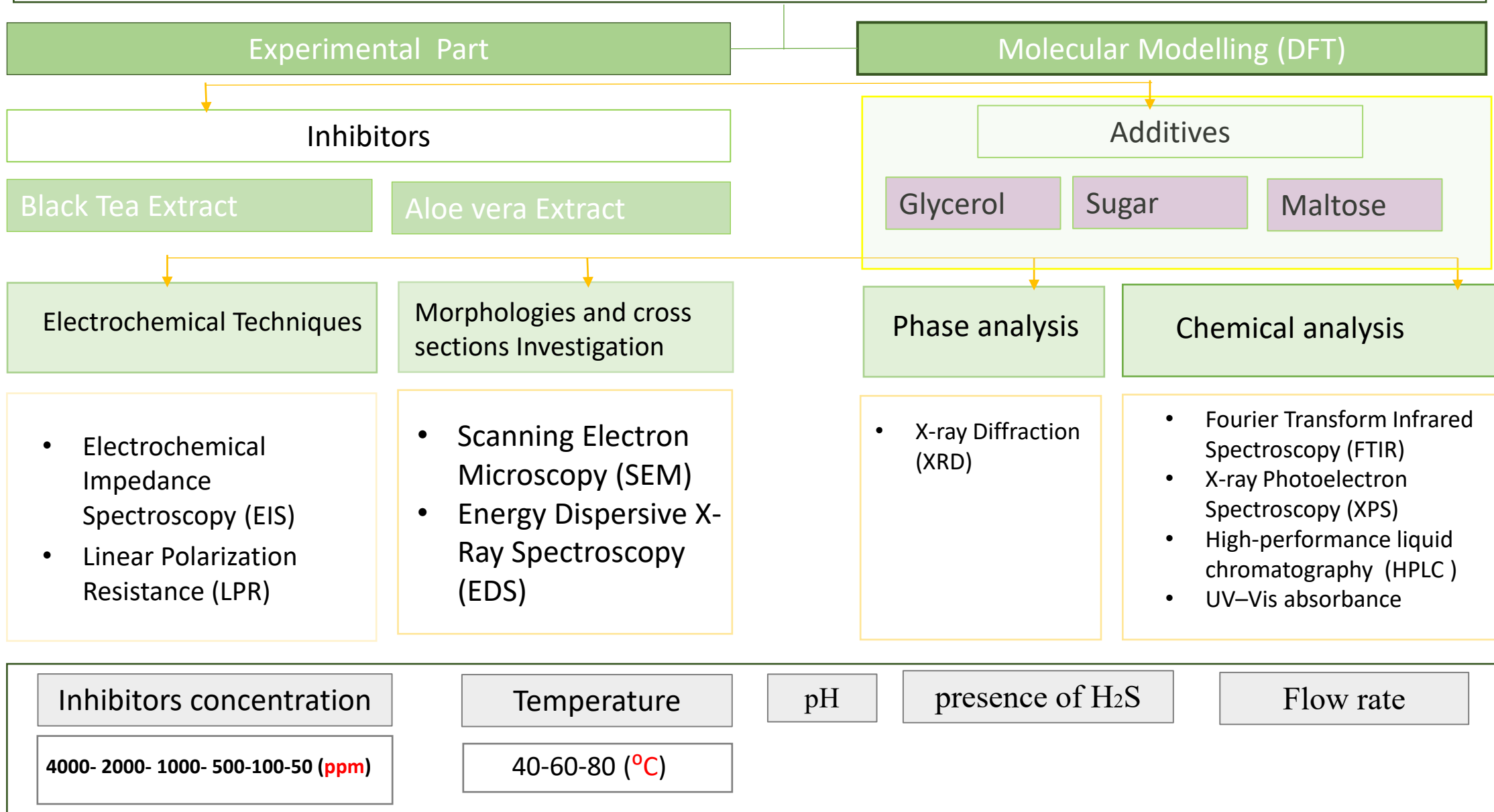
Assoc.Prof. *Martin Andersson*

Prof. Rajan Ambat

Introduction



Green corrosion inhibitors for corrosion prevention of carbon steel under CO₂ conditions

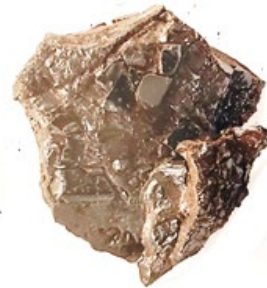


Material and methods

Table 1. Chemical composition in wt % of the L80-1Cr steel.

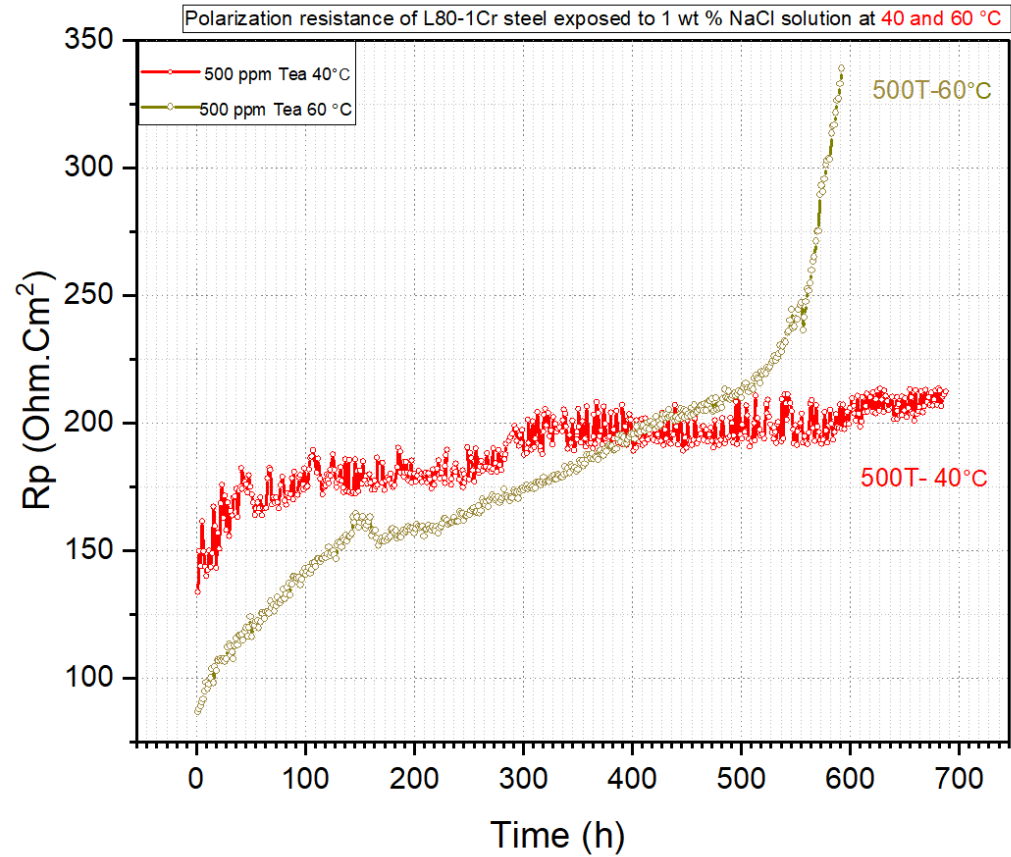
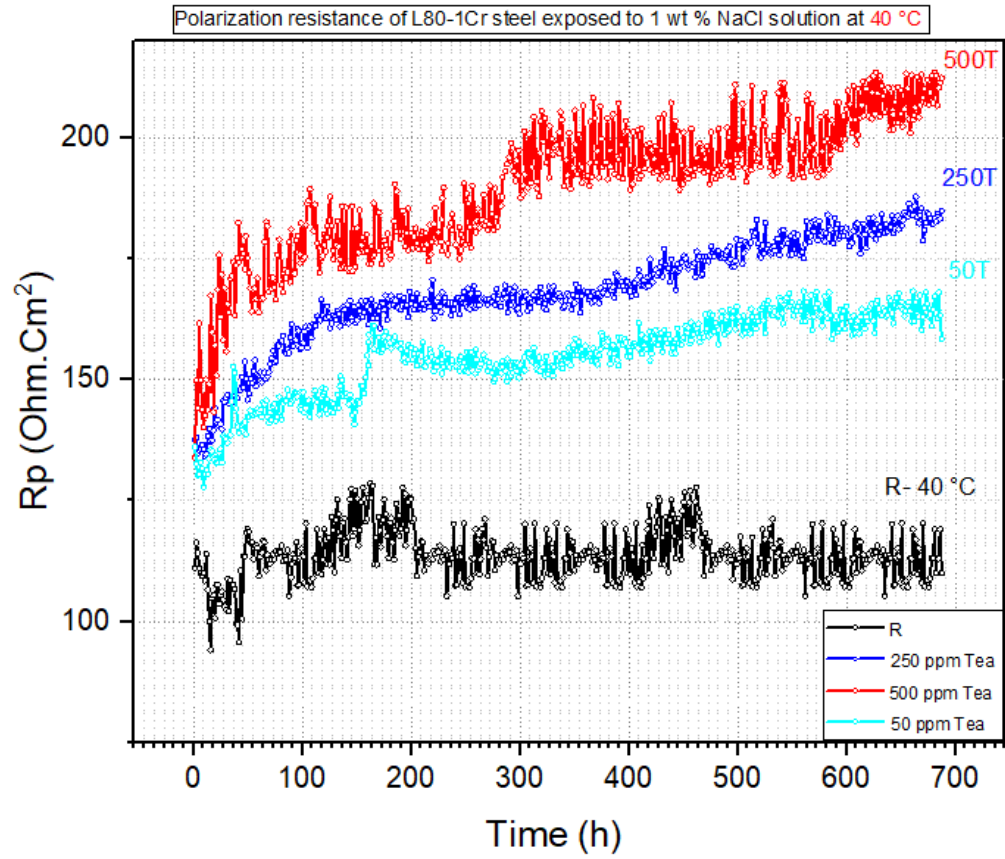
Material	C	Cr	Mn	Mo	P	Si	S	Fe
API 5CT L80	0.40	1.10	0.75	0.20	≤ 0.035	0.20	≤ 0.040	base

Tea extract



LPR-Results Rp

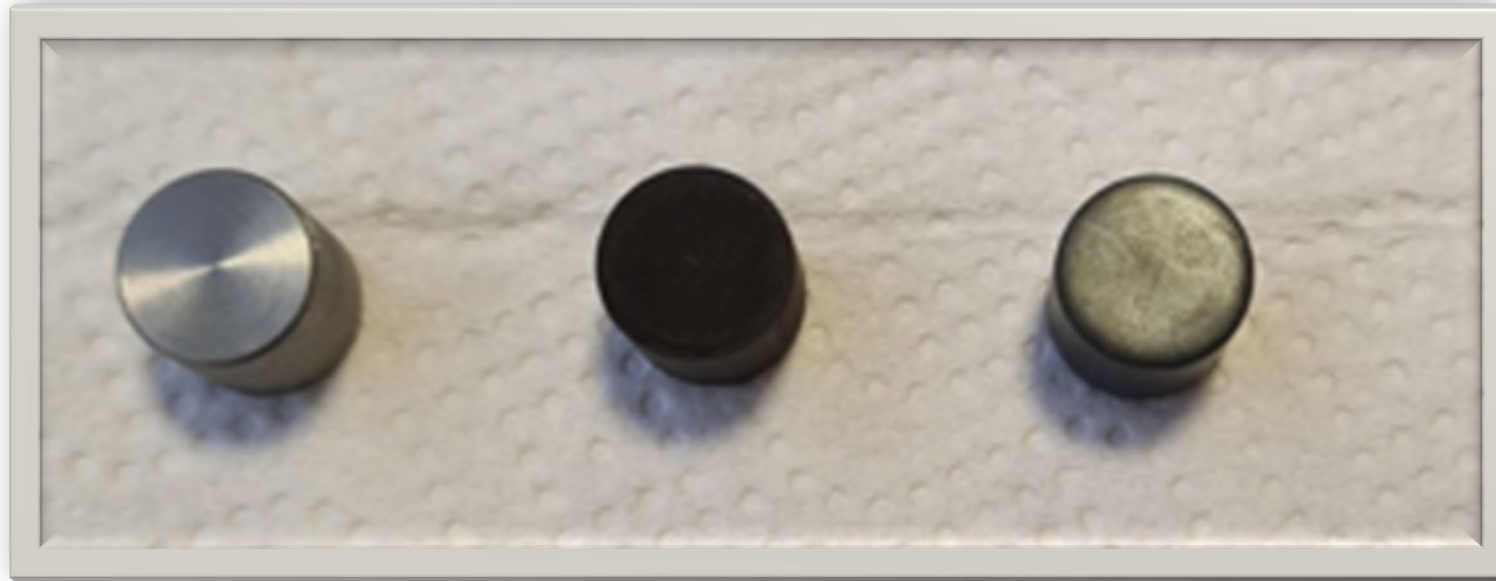
Long term- 700 h at 40°C



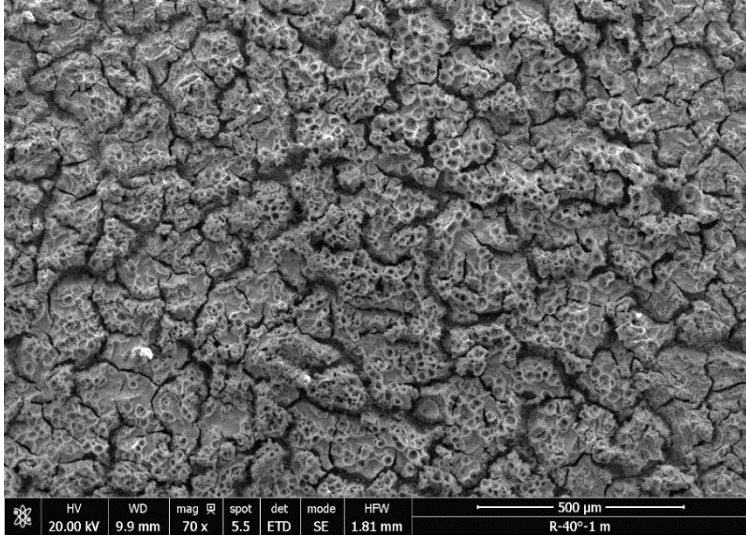
Sample before
immersion

Sample immersed
without inhibitor

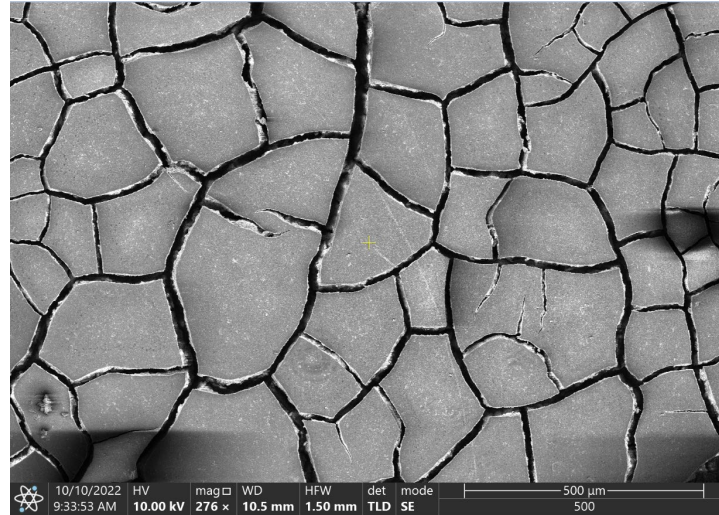
Sample immersed
with inhibitor



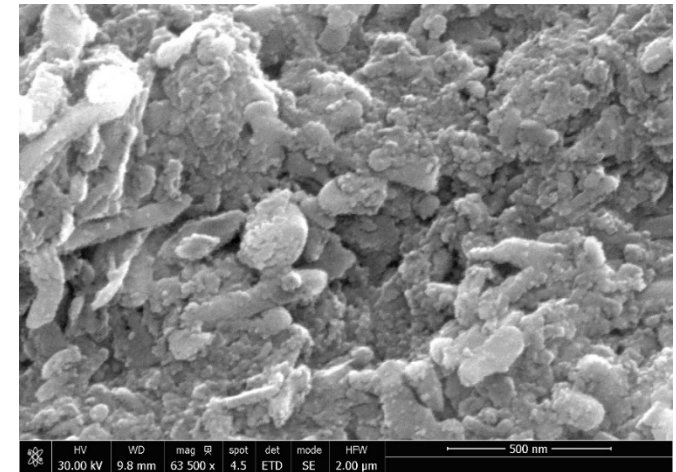
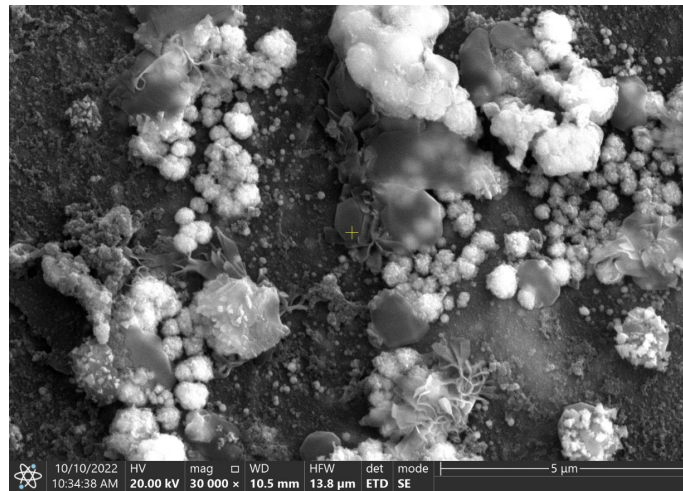
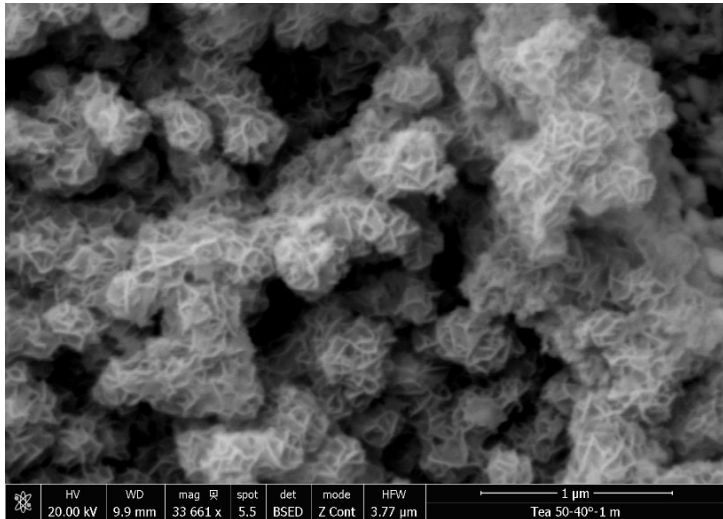
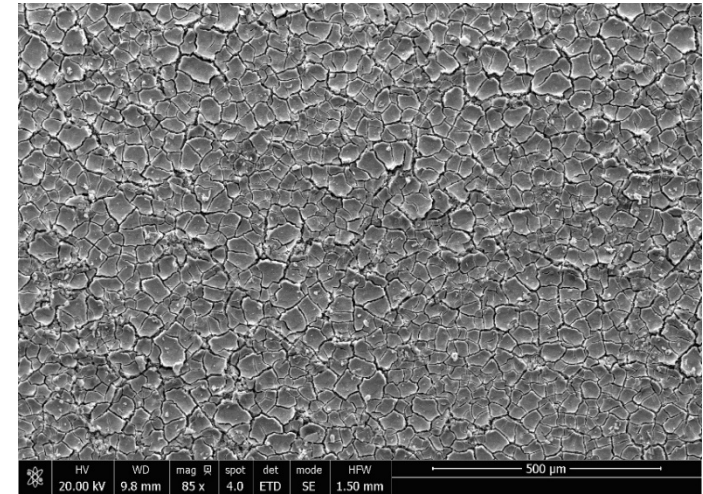
R-40 °C



500 ppm Tea 40 °C



500 ppm Tea 60 °C



Our Poster
Please join for more discussion

DTU

Black tea extract as an eco-friendly corrosion inhibitor for mild steel under CO_2 condition
* Ghada Shaban¹, Martin Andersson², Rajan Ambat¹

¹Denmark Technical University of Denmark, Produktionstorvet 425, Kongens Lyngby, 2800 Denmark
²Department of Chemical Engineering, Produktionstorvet 228, Kongens Lyngby, 2800 Denmark
*ghsha@dtu.dk

I. Introduction

In oil and gas industry, carbon steel pipelines are subjected to different type of corrosion. To mitigate corrosion, the injection of inhibitors is one of the most efficient and economic approaches. In the literature the approach on green inhibitor is almost aimed at application in acidic media. However, the inhibitive ability in neutral media has been slightly investigated, so there is a need for a better understanding of inhibition process of different compounds of inhibitor in neutral media. In addition, the importance of reusing green products waste as a source of potential corrosion inhibitor, which can be interesting from economic point of view. This study present Black Tea extract as a green inhibitor in neutral media.

II. Project motivation and research objectives

- ☐ Comprehensively understanding the correlation between the inhibitive ability of BTE and operational parameters (temperature, pH, inhibitor's concentration) on CO_2 corrosion resistance of 1 Cr steels BTE by means of advanced materials characterization methods, ultimately shedding light to the mechanisms responsible for the inhibition effect.
- ☐ Systematic molecular modelling study of inhibitor chemistry; key molecule within the extract causing inhibition will be identified and modelled for calculating adsorption energy.

III. MATERIALS AND METHODS



Preparation of sample

Table 1. Chemical compositions in wt % of the L80-1Cr steel.

Material	C	Cr	Mn	P	Si	S	Fe
AISI 5Cr L80	0.40	1.10	0.75	0.20	0.015	0.20	base

Preparation of Tea extract

The extraction process was performed using the aqueous solvent method

BTE Using 50ml Ethanol BTE Using 100ml Ethanol

Experimental conditions and procedure

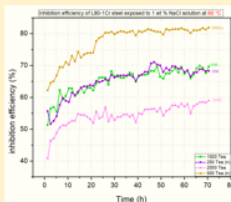
Specimens	L80-1Cr
Electrolyte solution	1 wt. % NaCl solution saturated with CO_2
Electrochemical tests	DC polarization, AC impedance and immersion methods
Surface characterization and phase analysis	SEM, EDS, and AFM
Chemical analysis	Uv-vis, HPLC, FTIR and XPS
Operational parameters	Temperature: 20, 40 and 60 Test duration: 3 days and 30 days Pressure: 0.93 bar Rotation: 200 rpm

IV. Preliminary results

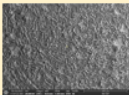
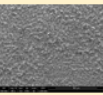
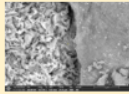
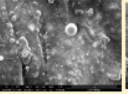
Inhibition Efficiency at 40C°



Inhibition Efficiency at 60C°



SEM images

Reference	40C°	60C°
		
		

References

[1] Z.M. Wang, G.L. Song, J. Zhang, *Frontiers in Materials*, 6 (2019) 1-16.
 [2] L. Wei, X. Pan, K. Gao, *Corrosion Science* 136 (2018) 339-351.
 [3] Y. Tang, X.P. Guo, G.A. Zhang, *Corrosion Science* 118 (2017) 118-128.
 [4] Y.S. Choi, S. Neeb, *Int. J. Greenh. Gas Control* 5 (2011) 788-797

DTU Offshore
Danish Offshore Technology Centre

DTU Construct
Section of Materials and Surface Engineering