

INFLUENCE OF DIFFERENT MAGNESIUM SOURCES IN DOPING MOLTEN SALTS FOR THE MITIGATION OF CORROSION FOR CSP/CST TECHNOLOGIES

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INTRODUCTION

The chemical and thermochemical characteristics of molten salt mixtures are key factors in their use as a source of thermal energy storage in a CSP/CST plant. The presence of impurities in these mixtures can affect not only their thermochemical properties but also their corrosivity. In this field, some studies indicate that the presence of magnesium (as an impurity) can slow down the corrosion process caused by molten mixtures [1, 2]. On the other hand, the use of doped molten salts has become an excellent strategy for increasing the efficiency of CSP/CST plants [3], although there are still not many studies in this area on the influence of doping agents on the corrosion of the plant's metallic materials.

This paper aims to present the first results of the study about the doped LiNaK carbonate molten salts with magnesium from different sources and with different particle sizes (nano and micro) on the corrosion rate of stainless steel AISI 430.

METHODOLOGIES

PREPARING THE MOLTEN SALT MIXTURES

Four mixtures of molten salts eutectic Li_2CO_3 - Na_2CO_3 - K_2CO_3 (32.1 : 33.4 : 34.5 wt%):

- **Without doping** (Li_2CO_3 Alfa Aesar – Na_2CO_3 Tata Chemicals Europe – K_2CO_3 Armand Products Company)
- 1% MgO nanoparticles (SkySpring Nanomaterials, 99% purity, 20 nm) – **Nano**
- 1% of Basalt Scale 2 (Azores islands, 3% Mg, 0.25 mm) – **BS2**
- 1% of Basalt Rock Powder (Azores islands, 4,5% Mg, 0.063 mm) – **BRP**

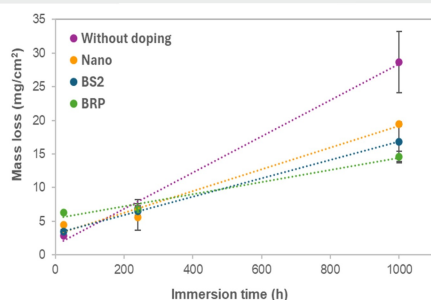
CORROSION TESTS

The corrosion tests were carried out in a muffle furnace at 650 °C where the AISI 430 steel was in direct contact with each of the mixtures for 24, 240 and 1000 hours, under static conditions and atmospheric air.

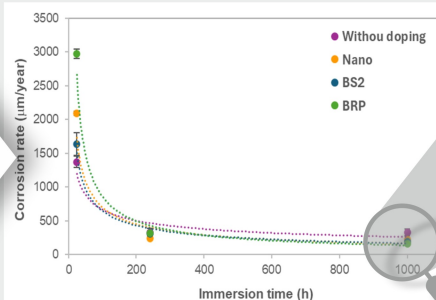
OXIDES CHARACTERIZATION

Characterization of samples by SEM/EDS and XRD.

RESULTS



$$CR(\mu\text{m/yr}) = \frac{87600\Delta m}{\rho t}$$

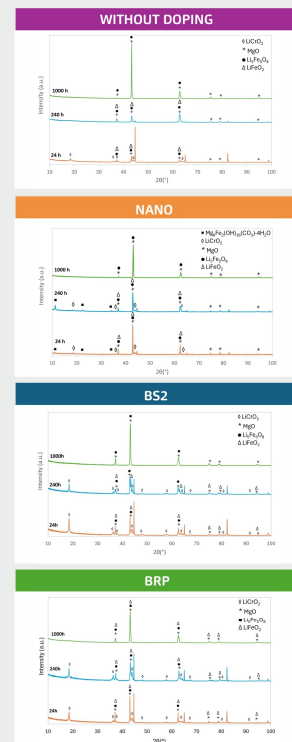
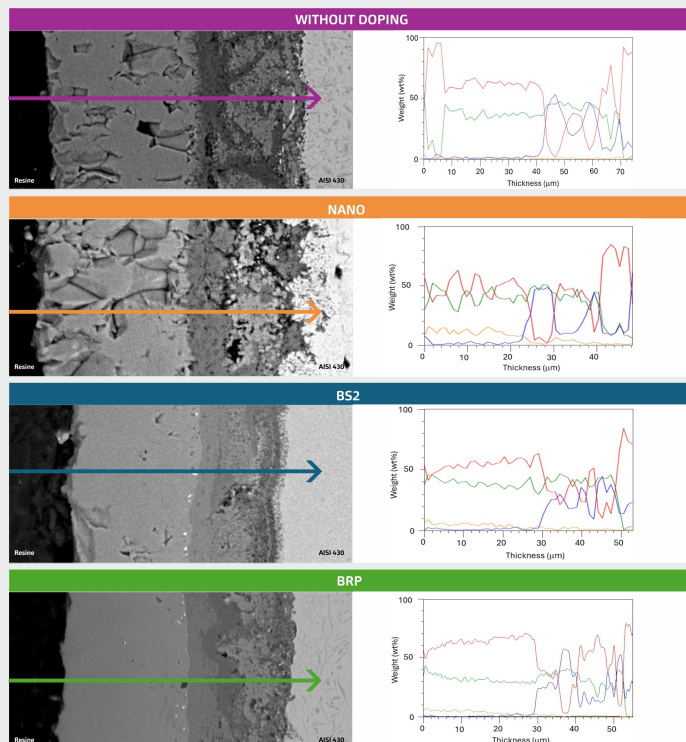
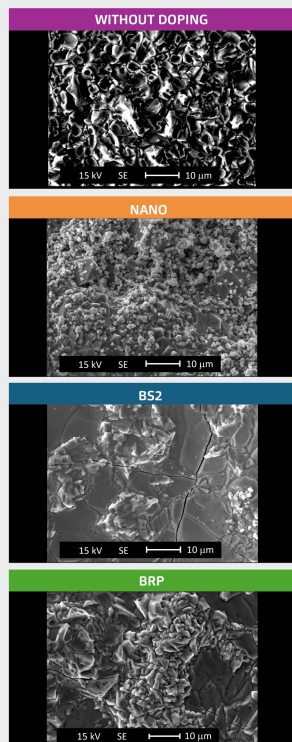


After 1000h at 650°C	
Salt	Corrosion rate (μm/yr)
WITHOUT DOPING	326 ± 51
NANO	221 ± 4
BS2	191 ± 33
BRP	166 ± 10

SEM Surface (1000 h)

SEM/EDS Cross-section (1000 h)

XRD



OK MgK CrK FeK

Note: unidentified peaks are from AISI 430

CONCLUSIONS

After 1000 hours of exposure, a shift in the corrosion rate trend was observed, with the mixture containing BRP exhibiting the lowest rate among all tested compositions. Although the oxide layers formed showed morphological differences, the same types of oxides were identified across all mixtures. These findings demonstrate that the presence of magnesium plays a significant role in mitigating the corrosion of AISI 430 steel when exposed to molten carbonate salts at 650 °C. However, the presence of different magnesium particles may change the chemistry of the salt in different ways, which could affect its corrosive behavior. Further study of the chemical and thermophysical properties of these mixtures is essential in order to understand their full impact.

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