VRIJE UNIVERSITEIT BRUSSEL

The faculty of Engineering of the Vrije Universiteit Brussel invites you to attend the public defense leading to the degree of

DOCTOR OF ENGINEERING SCIENCES

of **Eloa Lopes Maia**

The public defense will take place on **Friday 11th October 2024 at 4:00 pm** in room **D.2.01** (Building D, VUB Main Campus)

To join the digital defense, please click here
Meeting ID: 324 507 790 369
Passcode: nHGcGE

EARLY STAGES OF LIQUID METAL CORROSION – AUSTENITIC STAINLESS STEEL 316L EXPOSED TO LIQUID LEAD BISMUTH EUTECIC

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Abstract of the PhD research

Assessing the behavior of structural materials in contact with liquid metal is fundamental to developing new nuclear systems, such as lead-cooled fast reactors. For MYRRHA (Multi-purpose hybrid research reactor for high-tech applications), liquid lead-bismuth eutectic has been selected as the coolant for the primary system. Austenitic stainless steel 316L is intended for the manufacture of structural components, including the vessel and heat exchangers, based on its proven effectiveness in other nuclear reactor designs. However, prolonged exposure of this steel to liquid lead-bismuth eutectic can lead to liquid metal corrosion, potentially affecting its performance over the operational life of the nuclear system.

This research investigates how corrosion initiates in austenitic stainless steel 316L when exposed to liquid lead-bismuth eutectic, focusing on environmental factors such as temperature, dissolved oxygen concentration, and initial surface conditions, including ground and thermally pre-oxidized surfaces.

The study establishes a reference for corrosion initiation on polished surfaces exposed to stagnant liquid lead-bismuth eutectic, examining both the dissolution corrosion regime and the surface oxidation regime. It was also found that intermediate levels of dissolved oxygen in the liquid lead-bismuth eutectic intensify corrosion. A model was proposed to describe the corrosion mechanism.

Regarding surface conditions, the study found that ground surfaces exhibited a delay in corrosion, suggesting that surface roughness affects the onset of damage. On thermally pre-oxidized surfaces, the findings indicate that the oxide layer characteristics, such as thickness, chemical structure, and the presence of defects, significantly impact the onset of corrosion and the progression of degradation.

In summary, this study sheds light on the complexity of liquid metal corrosion, advancing the understanding of how environmental and surface condition factors influence the initiation of corrosion on stainless steel 316L when exposed to liquid lead-bismuth eutectic.