Liquid Metal Environment and Structural Materials

Fitriani C.A. [1,2], Gavrilov S. [1], Verbeken K.[2]
[1]Belgian Nuclear Research Centre, SCK•CEN, Mol, Belgium
[2]Research group Sustainable Materials Science, Ghent University, Ghent, Belgium

E-mail: **Cholidah.Akbar.Fitriani@sckcen.be**
Serguei.Gavrilov@sckcen.be
Kim.Verbeken@ugent.be

What are we doing?

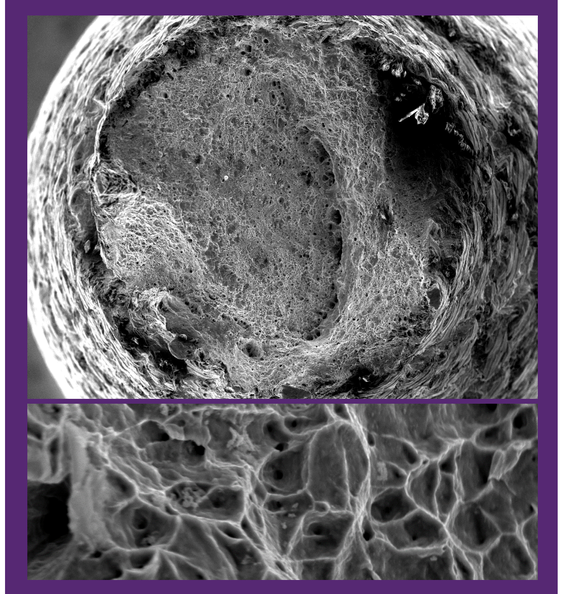
Developing methodology to assess the compatibilities between structural materials and liquid metal environments

Why do we study this?

- Performance of a structural material is sensitive to the environment to which this material is exposed
- Compatibilities between materials and environments in both existing and future nuclear reactors needs to be understood to:
  - Justify a safety case
  - Build predictive ability

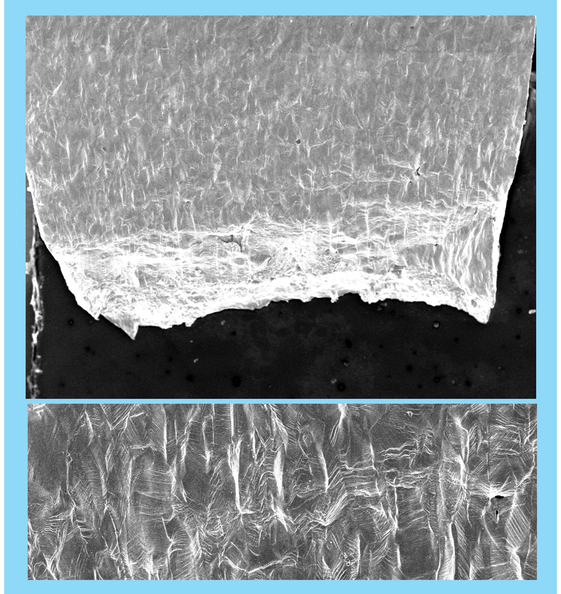
How are we going to do it?

Fractography



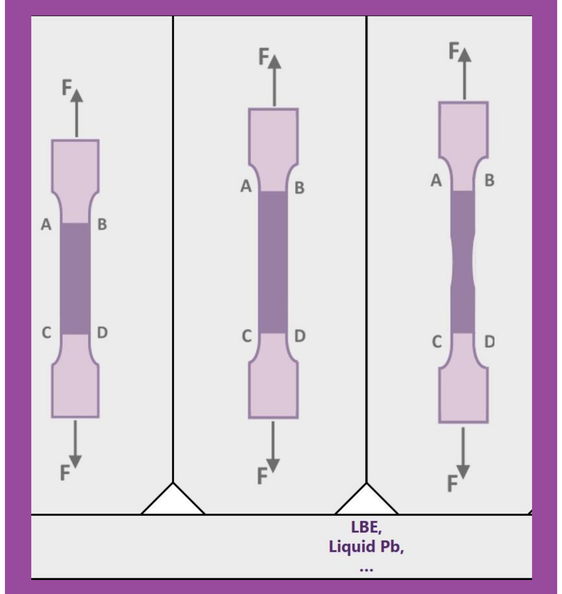
Fractography can help in identification of the micro-mechanisms involved

Surface Topography



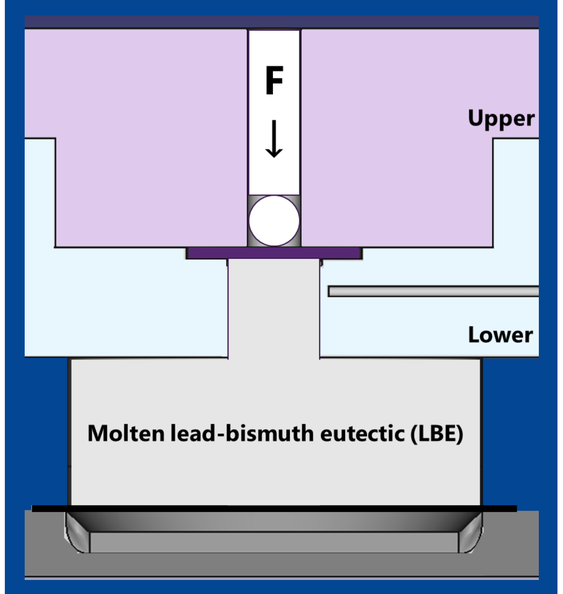
Metal/liquid metal interface play a role in determining bulk mechanical properties

Parametric Mechanical Tests



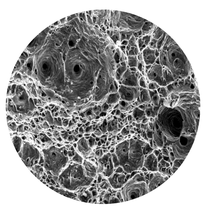
Parametric tests is used to study the sensitivity of materials to its operational conditions

Small Punch Test

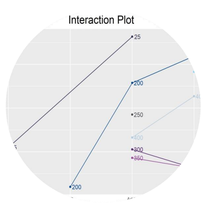


A newly standardized test[1] tailored for controlled liquid metal environments

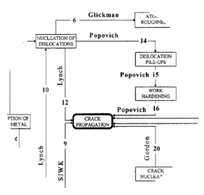
What do we expect?



Every interaction between material, loading type, and environment would leaves its specific signature on fracture surface



Fracture's signatures can be translated into quantitative data



Qualitative and quantitative observations of fracture surface can help in understanding the mechanisms of interaction

The newly proposed methodology can assess the interactions between materials and environments

What are those results for?

Future Reactors

Predictive ability to move forward

Material qualification program

Existing Reactors

Justification for safety cases

Background for root case analysis

of reactor components failure

REFERENCE:
[1] I. Serre and J.-B. Vogt, "Liquid metal embrittlement of T91 martensitic steel evidenced by small punch test," Nucl. Eng. Des., vol. 237, no. 7, pp. 677–685, 2007, doi: https://doi.org/10.1016/j.nucengdes.2006.07.007.

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