

Study of prototypical corium UZrO from quenching, by a multi-scale approach

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Corium is a complex material coming from the fusion of a nuclear reactor core at a very high temperature (2500 K). It can be generated in the case of serious accidents. The cooling mechanisms of this material in the liquid state can be varied : rapid in the case of contact with water as a quench, or slow in the case of contact with concrete. The solidification and the nucleation of phases formed, crystallized or amorphous, can be different depending on these mechanisms and will be characteristic of metals and oxides, and diffusion processes [1] [2] [3]. There is still little known today about all the stable and metastable phases formed in a prototypical corium coming from quenching.

The studies are being carried out on prototypical corium after quenching by water-corium interaction in the KROTOS facility of the LEAG laboratory at CEA Cadarache. The research will address the UZrO ternary compounds on a small solid sample (mm or less than 100 m size) by using characterization techniques to determine the microstructure, elemental composition and the crystallinity of phases (XRD, EBSD, STEM, SEM, EDS, Castaing Electron Probe Micro Analyzer) in the Analytical Chemistry and Metallography Laboratory at CEA Marcoule.

There are many challenges in the EPMA analysis of prototypical corium materials, due to:

- the sample heterogeneity, with phases of micrometric dimensions,
- native oxidation at ambient temperature after the metallographic preparation,
- the measurement of oxygen in the presence of heavy elements, particularly uranium in this case, which requires an optimization of the analysis conditions with fine-tuning of the electron beam and of the spectral analysis of the elements.

The methodology will be presented. The first results, collected by using characterization techniques and the determination of the grain size by EBSD (cf. figure 1 et 2), will be followed by a proposal concerning a solidification mechanism in two different trials with different compositions of prototypical corium UZrO.

REFERENCES

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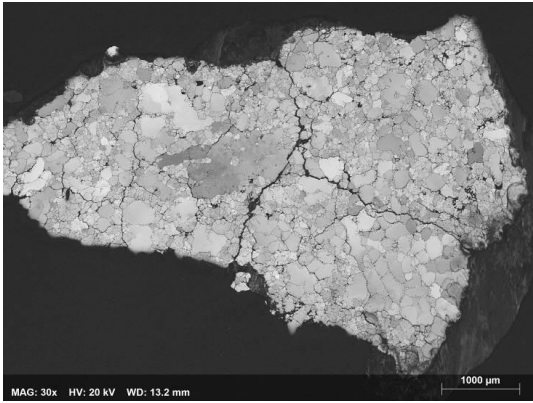


Figure 1: Micrograph of grain size obtained by EBSD

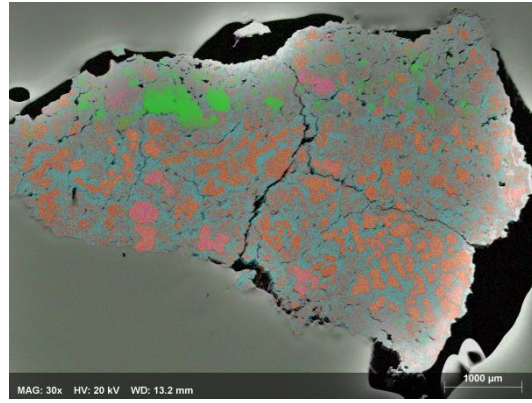


Figure 2: Phase cartography obtained by EBSD