

Investigation of solidification phenomena in metallic alloys by 2D & 3D observation

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Since solidification of metallic alloys at high temperatures forms original microstructure, which significantly influences properties of materials, it is important to understand solidification phenomena and the mechanism of microstructure evolution from viewpoints of fundamental and application approaches. However, it has been difficult to observe solidification *in-situ* and to know the mechanism empirically. Brilliant and monochromatized hard X-rays (>20keV) in third-generation synchrotron radiation facilities such as SPring-8 allows us to observe the solidification of metallic alloys *in-situ*.

Time-resolved X-ray transmission imaging with spatial resolution ranging from μm to mm has been used to study 1) dendritic growth of steel, Al alloys and so on, 2) microstructure evolution during solidification and phase transformation, 3) formation of casting defects (hot tears and macrosegregation), 4) deformation of semisolid (solid + liquid) and a physical model and 5) reaction and solidification at the interface between solders and substrates. The transmission imaging (2D observation) contributed to understanding the fundamentals of solidification. In addition to the 2D observation, time-resolved 3D observation (4D-CT) has been expected to contribute to further understanding. Recently, the 4D-CT is developed for observation the solidification.

In this presentation, recent progress of 2D and 3D observation techniques will be demonstrated. In addition, the massive-like transformation ($\delta \rightarrow \gamma$) in carbon steel, which was found by the observations, will be presented. Casting defects produced in the steel are discussed on the basis of the observations.

Bibliography

- [1] T. Nagira *et al*, *Metall. Mater. Trans. A*, **45A** (2014) 1415.,
- [2] G. Zeng *et al*, *Acta Mater.* **83** (2015) 357.
- [3] K. Yamane *et al*, *Metall. Mater. Trans. A*, **46A** (2015) 4937.

External links

<http://cast.mtl.kyoto-u.ac.jp>

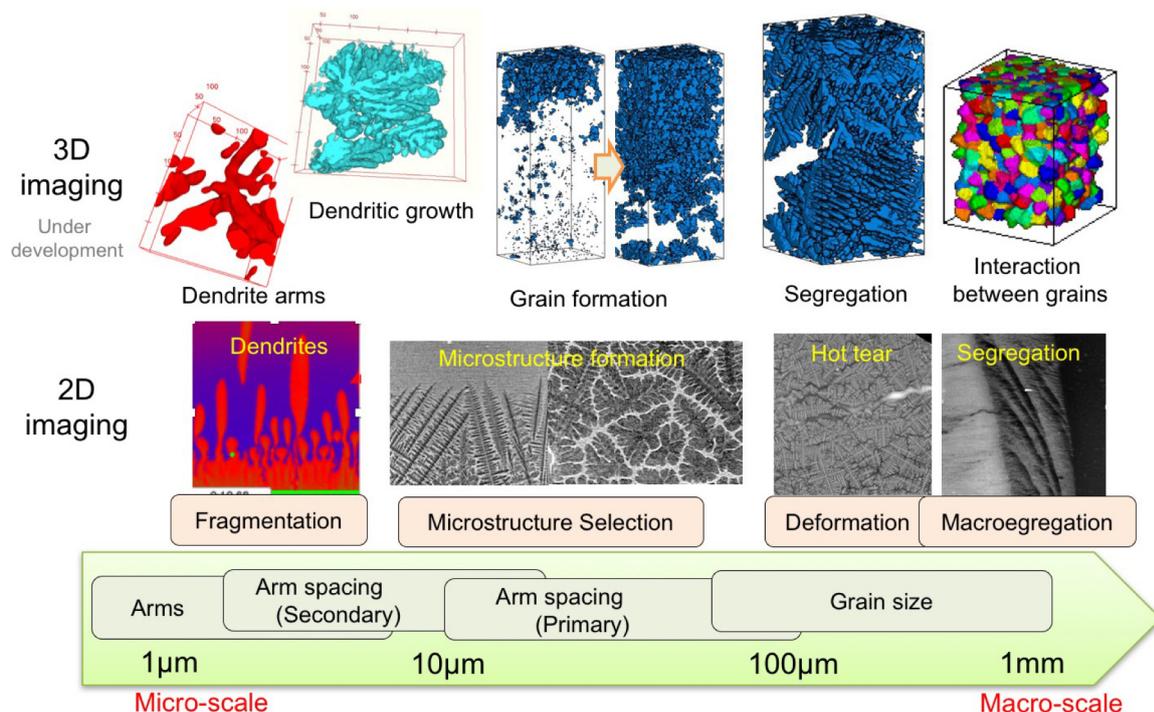


Fig. 1 Overview of 2D and 3D observations of solidification phenomena of metallic alloys.