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Fast synchrotron X-ray tomography of dynamic processes in metallic foams

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Summary: Series of fast synchrotron X-ray tomographies are taken continuously at a sub-second temporal resolution while aluminium alloy precursors are foamed in an X-ray transparent setup for several minutes. The entire foaming process from the solid precursor to the expanded liquid foam is captured and the gas nucleation and bubble growth analysed.

1. INTRODUCTION

To understand the influences on the final foam structure of metallic foams, knowledge about the mechanisms of bubble formation, growth and degradation has to be improved. Recent developments at synchrotron X-ray tomography beamlines offer the spatio-temporal resolution that is required to capture dynamic processes which occur during foam evolution and resolve the complex three dimensional structural evolution over time.

2. EXPERIMENTAL METHOD

The experiments were performed at the Tomcat beamline of the Swiss Light Source synchrotron facilities in Villigen, Switzerland. Series of synchrotron X-ray tomographies were taken continuously while heating a foamable aluminium alloy precursor with an IR laser in an X-ray transparent crucible (Fig. 1(a)) allowing to observe the whole foaming process for up to 150 seconds in sub-second temporal resolution (Fig. 1(c)) [1]. The quantitative analysis of the obtained four dimensional data has been performed in terms of the evolution of pore number, size distribution and shape development.

3. RESULTS

Appearing bubbles were counted and further growth, leading to a wider size distribution over time, was quantified (Fig. 1(b)). Coalescence of bubbles has been observed and bubble shape evolution has been followed revealing a deeper insight into the nucleation process [2].

References

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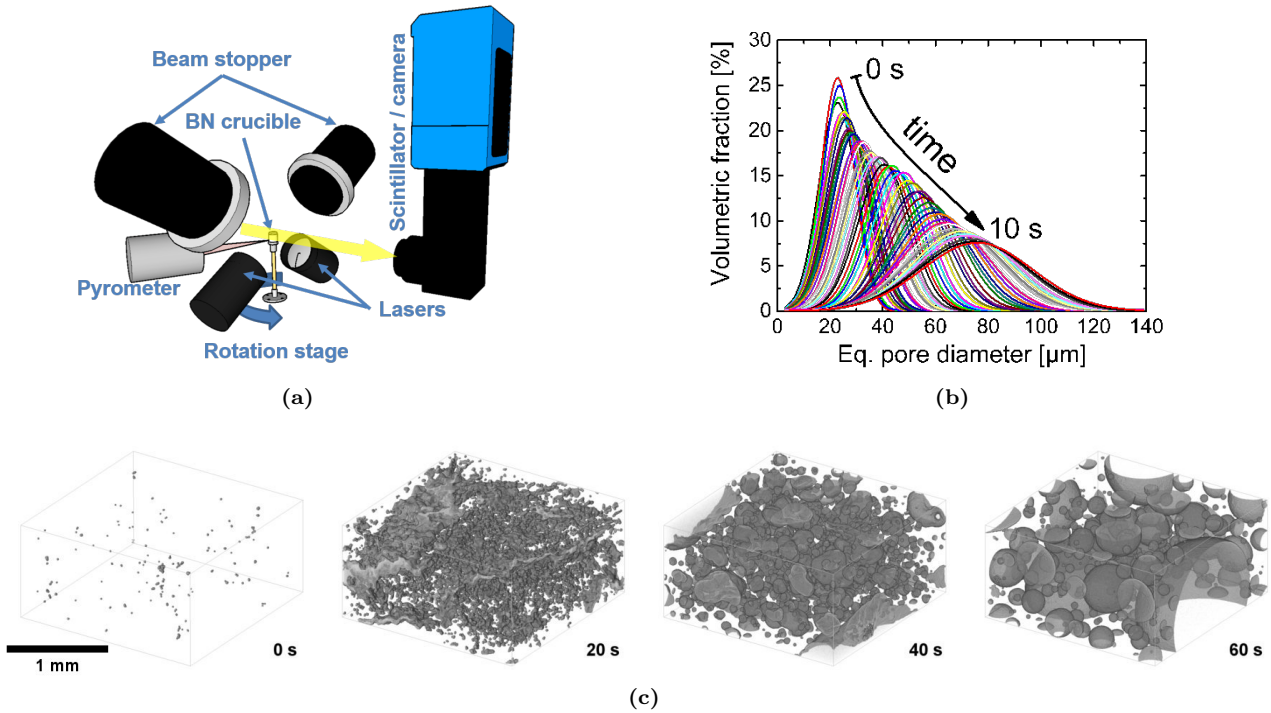

Figure 1: (a) Setup for *in-situ* experiments at Tomcat. (b) Bubble size distribution evolution during the nucleation stage. (c) 3D rendering of the foam structure evolution.