# Full-field synchrotron-based micro-tomogaphy and high speed radioscopy on multi-constituent, micro-structured material systems

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**High resolution synchrotron-based tomography investigations of metal foams and rapidly resorbable bone substitute materials in a regenerating bone defect (ceramics like Bioglass, Cerasorb) have been performed. Subsequent 3D image analysis was applied to derive quantitative results from the volume images. Additionally, high speed radioscopy was used to image *in situ* fast processes in metal foams.**

**Micro-structured, multi-component material systems are of high interest due to their broad range of application fields: aluminum foams with their high specific stiffness are very interesting for lightweight constructions but on the road to industrial applications there is still a need for basic approaches to control their final pore structure [1]. Biodegradable ceramics are an alternative to autogenous bone grafts for supporting the bone regeneration in defects which can occur e.g. after tooth loss. Different biocompatible materials are available on the market, which demands detailed investigations in order to optimise their properties for the various clinical applications [2].**

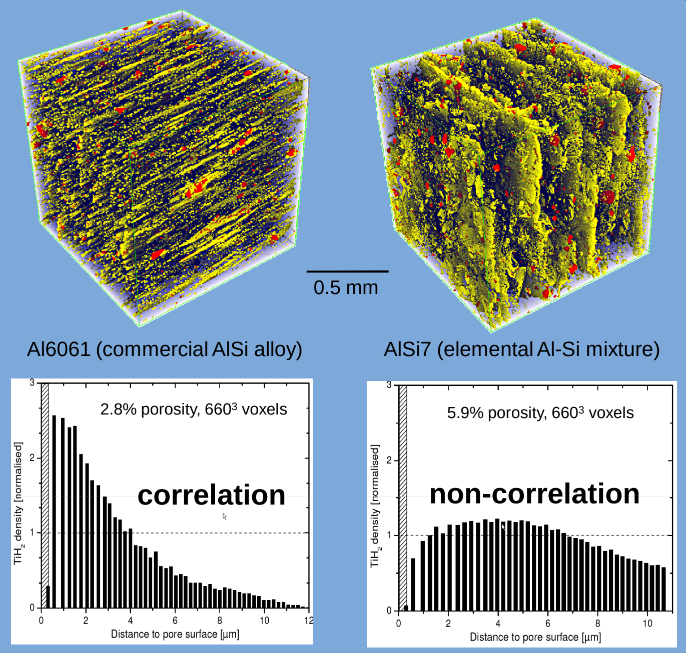


**Fig 1:** Volume rendering of segmented tomographs showing Al foams in early expansion stage and results of the image analysis [1].

**For aluminum foams produced from a pre-alloyed powder Al6061 (aluminum, silicon) it is known that pores and blowing agents' particles are spatially correlated in all foaming stages. In AlSi7 produced from a mixture of pure aluminum and silicon powders we could prove spatial non-correlations between the TiH2 particles and the early pores. This surprising result points out that there are different pore creation modes in the early stages of metallic foams which influence the spatial position of the first pores in the evolving foam matrix [1, 4] .**

**Another example for micro-tomography in materials science is the analysis of bioregeneration in bone defects (fig. 2), using a quantitative comparison between micro-tomography and histomorphometry. The bone regeneration is locally supported by bioceramic particles. Our findings indicate that a 2D analysis via histological cuts is not realiable in order to investigate the formed bone [2].**

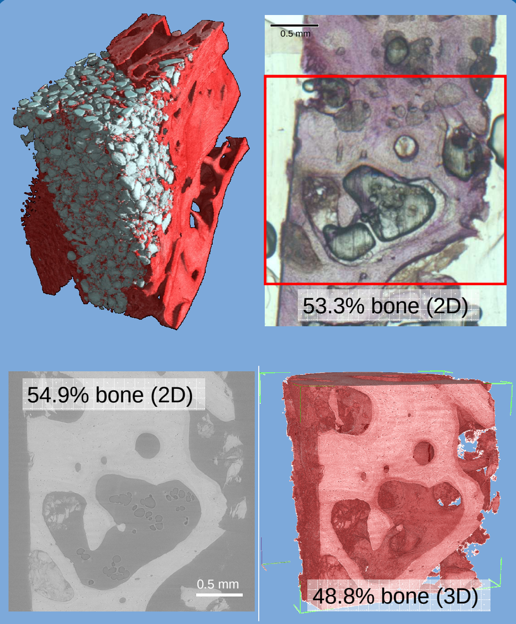


**Fig 2:** bio-regenerating particles in a sheep mandible and quantitative comparison between tomography vs. histomorphometry [2].

**A further method used is high speed microradioscopy to image fast processes in liquid metal foams (fig. 3). Using a framerate of 40000 images/s, we could sample a coalescence event in a liquid metal foam (duration approx. 2 ms) with 80 images (25 µs time sampling, 20 µm spatial sampling). This spatio-temporal micro-resolution allows one to investigate the driving forces behind cell wall collapses during foaming.**

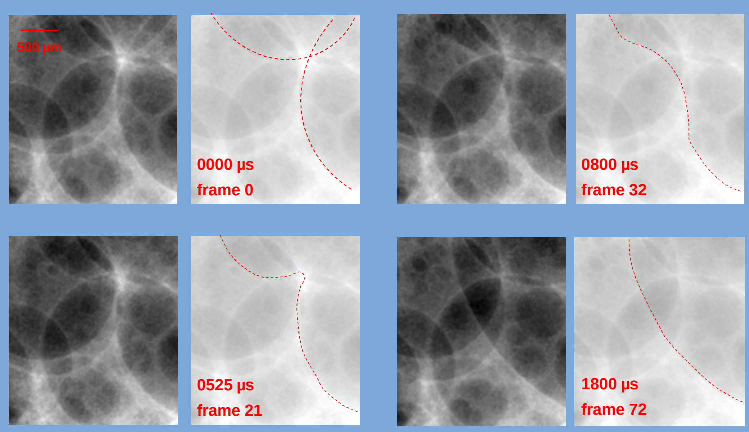


**Fig 3:** Image sequence taken out of a series of 184 000 which shows the merging of two pores (25 µs exposure time / 40 000 FPS, 20 µm effective pixel size): left – raw data; right: sketch highlighting major features [6,7,8].
http://www.alexanderrack.eu/ieee_movie.avi

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*see as well http://www.alexanderrack.eu*