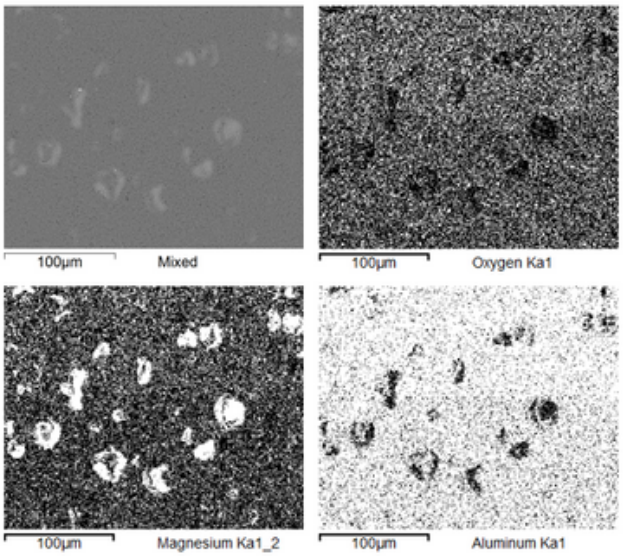
ADDITIVE MANUFACTURING OF CUSTOMIZED CERAMIC DENTAL IMPLANTS SUBSEQUENTLY JOINED WITH BIODEGRADABLE METAL CORES

-NEWSLETTER 2-

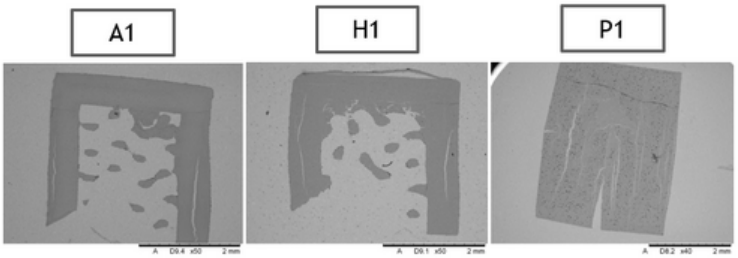
During the project's first year of realization, T2.1 task was completed within WP2, in which two infiltration methods were tested: squeeze casting and investment casting. Samples with different material compositions and various degrees of porosity were infiltrated. The applied preforms were created in the form of beams, which are planned to be further subjected to mechanical properties and thermal expansion evaluation. The ceramic 3D prints were prepared by NTUT with the main aim to fabricate open porosity.

Three types of structures were used for testing (A, H, P). Infiltration of samples type A and H was unsuccessful, as their macro porosity was infiltrated, but the internal one wasn't, probably due to the too low pressure. It was observed that the infiltration efficiency of sample P1 was partial, as only a few internal porosities were saturated with AZ91 alloy. The best outcomes were obtained for sample P2, where the thorough infiltration of larger open porosities was stated - even within the ceramic itself.



Mapping of O, Mg, Al distribution for sample P2

After SEM tests, the porosity of the samples was also determined. The project proposal assumed a residual porosity of 1 – 2%. All infiltrated samples had a porosity of less than 1%. It highlights the effectiveness of the squeeze casting process that utilizes pressures above 100 MPa.



Exemplary SEM images of samples after the first infiltration using the squeeze casting method

In the first trial, ceramic tooth has been completely infiltrated, but the solid section of the preform, which mimics the tooth crown, was detached. This damage probably occurred during pouring with liquid metal due to the thermal shock and thermal expansion mismatch between composite's constituents. The next attempts of infiltration of a ceramic tooth were more successful, achieving full saturation and high-quality of connection between ceramic scaffold and magnesium core.

The adopted approach serves for preliminary elaboration of proper connection between materials used to create such complex ceramic-magnesium composites, allowing for a basic interface assessment. Future studies will need to include a design of mounting system of the implant into the patient's jaw.

Ceramic tooth after infiltration: A - first trial; B - next attempts