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Additive manufacturing of porous structures for medical applications

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The development of modern medicine is possible through extensive cooperation of interdisciplinary teams, bringing the latest achievements in many fields of science, to implement new methods, materials and technologies. Regeneration of large tissue defects caused by tumour resection or lost as a result of accidents is one many challenges faced by surgeons. Individualized (custom-made) implants, shape-fitting patients' anatomies, are now easier to obtain thanks to modern computerised technologies, such as additive manufacturing (AM). Advanced 3D-printed implants eliminate the need for traditional treatments utilising autogenous one transplants with additional surgery site or conventional implants, and lower the risk of infections or implant loosening due to incomplete geometric adjustment. One of the main advantages of additive manufacturing is in fact the capability of producing objects with complex geometries and varying mechanical parameters in their different zones. Bone-replacement biomechanical functional structures (BFS) with diversified structure may be used to fill bone defects resulting from injuries or diseases and offer an effective method of counteracting existing dysfunctions of a patient. Designing and manufacturing of BFS structures for medical applications is an innovative and interdisciplinary issue, which becomes more and more popular but requires further research and development.

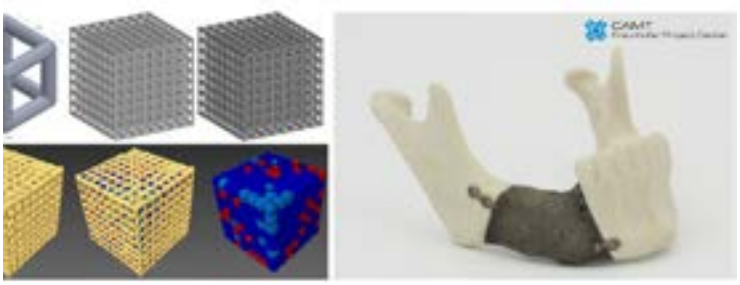

Figure 1: Custom-made implant made of Ti6Al7Nb alloy filled with porous structure

Recent Publications:

1. Szymczyk P, Ziółkowski G, Junka A and Chlebus E (2018) Application of Ti6Al7Nb alloy for the manufacture of biomechanical functional structures (BFS) for custom-made bone implants. Materials 11(6):971.
2. Dydak K, Junka A, Szymczyk P, Chodaczek G, Toporkiewicz M, Fijałkowski K, Dudek B and Bartoszewicz M (2018) Development and biological evaluation of Ti6Al7Nb scaffold implants coated with gentamycin-saturated bacterial cellulose biomaterial. PLoS ONE 13(10):e0205205.
3. Junka A, Szymczyk P, Secewicz A, Pawlak A, Smutnicka D, Ziółkowski G, Bartoszewicz M and Chlebus E (2016) The chemical digestion of Ti6Al7Nb scaffolds produced by selective laser melting reduces significantly ability of Pseudomonas aeruginosa to form biofilm. Acta of Bioengineering and Biomechanics 18(1):105-110.

4. Pawlak A, Szymczyk P, Ziółkowski G, Chlebus E and Dybała B (2015) Fabrication of microscaffolds from Ti-6Al-7Nb alloy by SLM. Rapid Prototyping Journal 21(4):393-401.

5. Szymczyk P, Junka A, Ziółkowski G, Smutnicka D, Bartoszewicz M and Chlebus E (2013) The ability of S. aureus to form biofilm on the Ti-6Al-7Nb scaffolds produced by selective laser melting and subjected to the different types of surface modifications. Acta of Bioengineering and Biomechanics 15(1):69-76

Biography

Patrycja Szymczyk received her PhD (2015) degree from the Wrocław University of Science and Technology. She is an Assistant Professor at the Faculty of Mechanical Engineering of WrUST. Her current research interests are related to medical applications of AM technologies and includes the design, manufacturing and testing of advanced biomedical objects, such as biomechanical functional structures (BFS) for tissue regeneration, custom-made implants and smart drugs delivery systems for a wide spectrum of materials dedicated to the medical and pharmaceutical industry.

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