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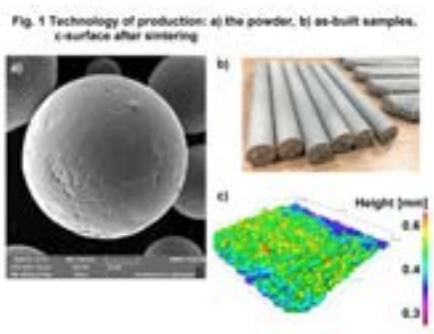
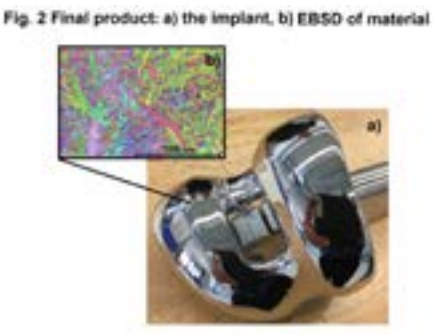
Advanced knee implants for the third millennium

This work deals with today's frequent problem of human joint replacements by applying of advanced radiology techniques (CT, MR, X-ray), application of powder materials and the modern additive (melting of metal powders by electron beam - EBM) and machining technologies. The main attention is devoted to the EBM used by the ARCAM Q10plus machine. A special attention is then paid to the data processing, optimization of design, technological parameters, quality of the produced materials and their post-processing, expressed by 3D topographies of the machined surfaces, machinability, mechanical and tribological properties. The studied technologies include turning, milling, belt grinding and tumbling, in dry conditions. In general, the material exhibits a high resistance to the machining, expressed in terms of specific cutting energies (KISTLER 9575B, Dynoware). Analyses of the samples were made to quantify the production precision and quality (electron microscopy Tescan MIRA 3GM, electron dual microscopy TermoFischer, Alicona IF G6, Mahrvision MM 420) after sintering in different technological modes. The final surface quality results in glossy surfaces (Ra<0.04 um) with high material ratios that enhance the resistance to fatigue crack propagations. The results are very encouraging because this advanced technology (starting at the basic surgical inspections up to the operation with advanced taylor-made implant) can offer an optimized implant that prevails in superior mechanical properties, light mass and excellent mechanical properties. Moreover, a bigger ratio of the original bone can be preserved so a longer life of the implants and reduction of re-operations and after-effects can be expected.





Recent Publications

1. Ryšavá Z, Brushi S, Píška M and Žídek J (2018) Comparing the performance of micro-end mills when micro-milling of additive manufactured ti-6al-4v titanium alloy. MM Science Journal 4:2543-2546.
2. Píška M, Trubačová P and Horníková J (2017) Analysis of powder steel material, laser sintering technology and machining on surface parameters and fatigue. Materialwissenschaft und Werkstofftechnik 48(7):1-11

Biography

Miroslav Piska has completed his PhD from Brno University of Technology University. He is the Director of Institute of Manufacturing Technology in Faculty of Mechanical Engineering from 2003. He has published more than 250 papers in scientific journals and conference proceedings and has been serving as an Editorial Board Member of 4 scientific journals and reviewer of 6 other scientific periodics.

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