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Plasma electrolytic oxidation of titanium to biofunctionalize surfaces of ventricular assist devices

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Ventricular assist devices (VAD) are prescribed for congestive heart failure patients to stabilize their hemodynamics until recovery or alternative therapy. The devices are essentially machined in commercially pure titanium (Ti cp) a biomaterial capable of providing stable biological integration without compromising implant biofunctionality or patient well-being. The promotion of biofunctional surfaces for VAD became possible through surface modification of VAD components in order to improve the interface between biomaterial and assisted organ. A process was developed using plasma electrolytic oxidation (PEO) technique to form a textured oxide layer in Ti cp. Scanning electron microscopy was used to certify the effectiveness of texturing. A methodology was elaborated to assess the feasibility of endothelialization by in vitro cellular growth with human umbilical vein endothelial cells (HUVEC). PEO process was able to provide a textured oxide coating in Ti cp; in which the micrograph, scaffolding characteristics, has a proportional size to circulating blood cells and endothelial. Magnesium incorporation has shown to be promising since extracellular membrane proteins of adherent cells need this element to exert their function. In vitro procedure indicated endothelialization in modified surface as the HUVEC adhered three times more on coated titanium oxide compared to the observed in the experiment with pure polished titanium. Endothelization in VAD tends to occur in vivo during circulatory assistance; the presence of a thrombosis-resistant neointima at the interface between implant/circulating blood aims to reduce the induction of heparin as anticoagulant thus assigning lower hemolysis due to higher absorption of tensions shear per flow to the surface of VADs.

Recent Publications:

1. Bock E G P (2016) Review of introductory tests to in vivo evaluation, prototypes assembling and anatomical position studies after five years. International Journal of Advanced Robotics and Automation 1:1-3.
2. Bock E G P et al. (2016) Left ventricle failure and blood flow estimation for centrifugal blood pumps. Journal of Mechanics Engineering and Automation 6:162-166.
3. Lopes G, Bock E G P and Gómez L (2017) Numerical analyses for low Reynolds flow in a ventricular assist device. Artificial Organs 41(6):E30-E40.
4. Uebelhart B et al. (2013) Study of a centrifugal blood pump in a mock loop system. Artificial Organs 37(11):946-949.
5. Bock E G P et al. (2011) Implantable centrifugal blood pump with dual impeller and double pivot bearing system: electromechanical actuator, prototyping, and anatomical studies. Artificial Organs 35(5):437-442.

Biography

Eduardo G P Bock holds a Degree in Mechanical Engineering from Sao Judas Tadeu University (2003); a Masters (2007) and PhD (2011) in Mechanical Engineering from the State University of Campinas – Unicamp, Brazil respectively. He is currently an Associate Professor (class D-IV) in the Laboratory of Bioengineering and Biomaterials (BIOENG) of the Department of Mechanics at Federal Institute of Technology (IFSP), Sao Paulo (Brazil). He has experience in the field of biomedical engineering with emphasis on bioengineering, working mainly in the following subjects: biomaterials, tribology, numerical simulation, artificial organs, artificial heart, circulatory assistance, left ventricular assistance and extracorporeal circulation.

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