Study of surface characteristics of biomaterials used for medical devices and biosensors

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INTRODUCTION

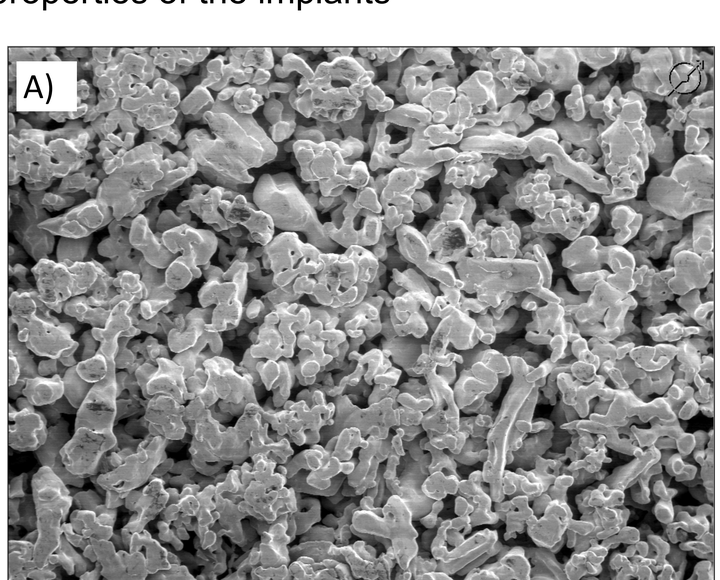
The geometry, structural properties and importantly surface features of implants play an important role on their biocompatibility and post implantation induced foreign body response [1]. The formation of fibrotic tissue in the surrounding of implants can define their fate and potentially hinder the performance of medical devices by creating diffusional barriers for oxygen and nutrient transport [2-4]. The reduced transport dynamics can then lead to creation of hypoxic conditions affecting tissue function and performance of the implants [5,6]. It is therefore crucial to study the surface features and characteristics of biomaterials prior to implantation. In this study, porous pure titanium and stainless steel (304), two widely used prosthetics implants due to their proper elastic modulus, biocompatibility and corrosion resistant, and the ability to control their surface features are studied [7-11]. This investigation focuses on surface characteristics of these materials which are mostly used on outer surfaces of medical devices and as orthopedic implants.

METHODS

Scanning electron microscopy (SEM) (performed by Quanta 600, FEI company) shows significant variability in the surface characteristic of all studied implant materials. The pore size and geometry is analyzed using MATLAB to map the pore distribution.

RESULTS

The difference in pore size, pore shape and distribution of the studied stainless steel and pure titanium is shown in Figure 1. Their different porous structures can cause differences in induced foreign body response and ultimately the function of the medical devices and implants using them as outer surfaces. Our image analysis shows a lower variety in pore size distribution and shape in stainless steel as compared to titanium. This might be because of higher ability to control the surface features for this material. These surface characteristics are important for medical devices because the induced fibrosis can change the diffusional characteristics, moreover the are crucially important for orthopedic implants as well, since the quality of the bone formed is greatly influenced by the properties of the implants



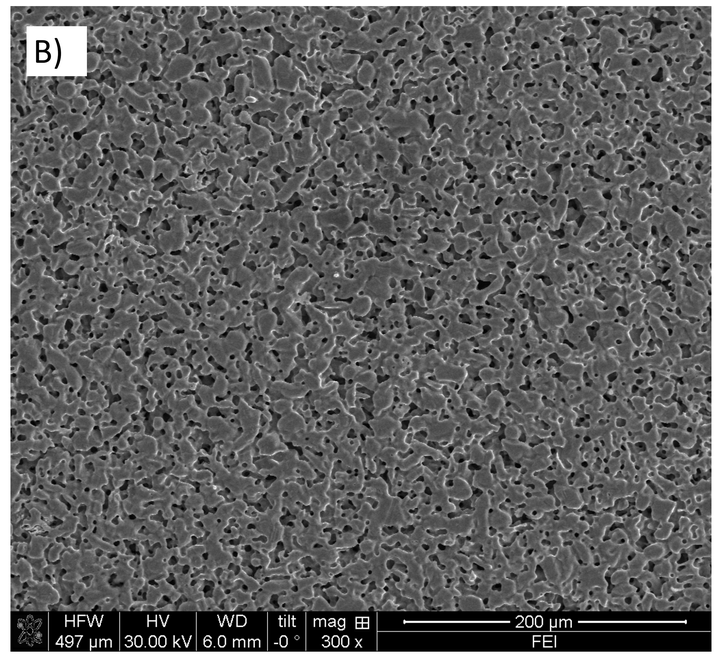


Fig. 1. Scanning electron microscopy (SEM) images of (A) porous stainless steel 314, (B) porous pure titanium.

This investigation can be further extended to *in vivo* studies and histological analysis, results can then show how changes in pore size distribution affects the foreign body response.

CONCLUSIONS

Our analysis matched with an extensive literature study on foreign body response of different materials and their surface characteristics confirms the importance of our investigation on selection of biomaterials with appropriate surface features based on their final use in medical devices or implant applications. The stainless steel has shown a higher uniformity in pore size distribution. Following studies will discuss the effects of pore distribution on mechanical and diffusional characteristics of these materials.

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