

Materials Science of Crystalline Bioceramics: A Review of Basic Properties and Applications

Robert B. Heimann¹

¹*Professor and Chair, Department of Mineralogy,
Freiberg University of Mining and Technology, D-09596 Freiberg, Germany
E-mail: heimann@tu-freiberg.de*

- I. Introduction
 - Socio-economic consequences
 - Design of endoprosthetic implants
- II. Concept and definition of biocompatibility
- III. Interaction of implant material and living tissue: a basic approach
- IV. Mechanical properties of advanced bioceramic materials
- V. Bioinert oxide ceramics
 - Alumina
 - Y-stabilized zirconia
- VI. Performance requirements and quality control of ceramic femoral balls
- VII. Bioactive hydroxyapatite ceramics
 - Biomimetic films
 - Thin films by surface modification
 - Thick coatings by plasma-spraying
- VIII. The need and role of bioinert bond coats
- IX. Novel developments and outlook
- References

I. INTRODUCTION

Socio-economic consequences. The number of patients requiring and receiving biomedical implants to correct skeletal defects and heal diseases are constantly increasing. Worldwide, large demand exists for load-bearing hip, knee and dental endoprosthetic implants, but also for bone replacement parts in the maxillar-mandibular area, the ossicular chain of the inner ear, and alveolar ridge and iliac crest augmentation. To date, in the United States and in Europe, more than 800,000 hip and knee arthroplasties are being performed annually, with increasing tendency.

The properties and function of biomaterials, in particular bioceramics are frequently being discussed in the context of hip endoprosthetic implants. Hence this review will deal with most commonly utilized bioceramic materials such as alumina, stabilized zirconia (Y-TZP, Y-stabilized Tetragonal Zirconia Polycrystal), and calcium phosphates, in particular hydroxyapatite.

The increasing demand for endoprostheses is the result of the wear and tear the hip and knee joints are subjected to during a human lifetime. Consider this: an average person