SUMMARY OF Ph.D. DISSERTATION

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Title

A Study on Surface Modification for Metallic Biomaterials by ELID Grinding

Abstract

Bio-implants, such as artificial joints and artificial tooth root, require high efficacy and precision processing, because their shapes are very complicated. In addition, the downsizing of bio-implants has been progressing, thus requiring ultra-precision processing techniques. Biomaterials used for bio-implants require certain desirable properties; such as chemical stability, high mechanical properties and biocompatibility. These properties depend on the quality of the surface. If we are able to form a high quality layer and a stable modified layer during the machining process, this will help us skip additional surface treatments and allow for significant saving in energy and machining procedures. The aim of the present study is to clarify the applicability of the ELID (Electrolytic In-process Dressing) grinding as a surface modification machining process for biomaterials.

Chapter 1 describes the background and objectives.

Chapter 2 shows the practicability of ELID grinding for the machining process for biomaterials such as titanium alloy and stainless steel. ELID grinding can obtain a high quality surface with low surface roughness.

Chapter 3 shows the practicability of ELID grinding for the surface modification process for biomaterials. Comparing the surfaces finished by ELID grinding and those finished by polishing indicates the possibility of omitting the additional surface modifying processes after machining.

Chapter 4 clarifies the effects of a surface modified layer created by ELID grinding on chemical properties and biocompatibility. A surface finished by ELID grinding has biocompatibility and a particularly high corrosion resistance compared to that of the polished surface because of the formation of a thick and stable surface-modified oxide layer. This surface does not induce a cytotoxic reaction nor alter the physiological or functional behavior of cells.

Chapter 5 clarifies the effects of a surface modified layer on mechanical properties. ELID grinding creates a very thin, hardened layer and produces a compressive residual stress on the surface. These improve the mechanical properties of the finished surface.

Chapter 6 describes the possibility of applying ELID grinding to various bio-implant systems.

Chapter 7 summarizes the results of the present study.