PREFACE

This was a long road walked on bare foot. During this walk, the suffer was permanent. But the success is the sum of the losses and failures we lived through this journey and the real men don’t talk about their losses.

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This thesis can not be terminated without sustainable support of my family. But over all, this master thesis is dedicated to my beloved sister, Müberra Burçin ÇETİNER who passed away in 2009, at the age of 23.

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ÖZET

Alümina 20 yıldan daha uzun bir süredir yüksek sertliğine eşlik eden düşük sürtünme, aşınma ve in vivo ortamda tepkimesizliği nedeni ile seçilen bir biyomalzemedir. Okside olan titanyumun rutil fazının biyouyumlu olduğu belirtilmiştir. Bu, biyocam ve sinterlenmiş hidroksilapatit (HA) gibi bazı seramiklerde keşfedilen bir özelliktir. Fakat alümina ve titanyanın meydana getirdiği tialit karışımı (Alüminyum titanat- 50 % mol Al_2O_3 ve 50 % mol TiO_2 yeni bir meydan okumadır. Bu çalışmada, ilk olarak Seydişehir alüminasını "Kral Suyu" asidik çözeltisinin içinde yıkayıp ıslahını, akabinde % ağ. 2.5, % ağ. 3.5, % ağ. 4.5 MgO ve % ağ. 1 SiO_2 ve kalanı alümina ve titania karışımı (1:1 mol) olacak şekilde harmanların hazırlanması sağladındı. 1600 ^oC 'de 12 sa bu harmanları sinterledikten sonra, mekanik özellikleri (basma ve sertlik testi) ve faz oranları (XRD analizi) analiz edildi ve Seydişehir alüminası yerine laboratuvar ölçeğindeki alümina –analitik saflık- içeren kontrol grubu ile karşılaştırıldı. Altlık malzemesinin karakterizasyonun ardından (SEM ve EDS analizi), iki farklı tür malzemenin karşılaştırılması gerçekleştirildi. Alümina-titanya biyokompositinin üretimini takiben, alev sprey prosesi kullanılarak sığır hidraoksiapatiti ile ısıl püskürtme kaplaması uygulandı ve kaplama tabakalarının karakterizasyonu (SEM ve EDS analizi ve mikrosertlik ölçümleri) yapıldı.

ABSTRACT

Alumina is a biomaterial of choice for more than 20 years due to its high hardness accompanied by low friction, wear and inertness to in vivo environment. It has been reported that titanium oxidized to the rutile phase is bioactive. This is a property discovered for certain ceramics such as Bioglass and sintered hydroxylapatite (HA). But the combination of alumina and titania forming tialite (Aluminium titanate-50 mol % Al_2O_3 and 50 mol % TiO_2) is a new challenge. In this work we made firstly the beneficiation of the Seydişehir alumina by leaching it in the acidic solution "the Aqua Regia" followed by preparation of batches containing 2,5 wt %, 3,5 wt % and 4,5 wt % of MgO as the sintering aid, 1 wt % of SiO_2 and the balance; the alumina and titania powder mixture (1:1 mole). After sintering these batches at 1600 ^oC for about 12 h, their mechanical properties (the compression and hardness testings) and phase ratios (the XRD analysis) were analyzed and compared with the control group containing the laboratory scale (analytical purity) alumina instead of the Seydişehir alumina. Following the characterization (the SEM and the EDS analysis) of the substrate material, the comparison of two different kinds of materials was carried out. Following the production of the alumina-titania biocomposite, the thermal spray coating using the flame spray process by bovine hydroxyapatite was applied and the characterization of the coating layers (the SEM & EDS analysis and the microhardness measurements) was performed.

SYMBOLS

E : Elastic Modulus

Å : Armstrong

^{o}C: Celcius

α : Linear dilatation coeffficient

Al_2O_3 : Aluminum Oxide-Alumina

SiO_2 : Silicium Oxide-Silica

Fe_2O_3 : Iron Oxide

Na_2O : Sodium Oxide

$Al(OH)_3$: Aluminum hydroxide

CaO : Calcium oxide-Calcia

MgO : Magnesium oxide-Magnesia

TiO_2 : Titanium oxide-Titania

Al_2TiO_5 : Aluminum titanate

La_2O_3 : Lantalum oxide

SnO_2 : Tin oxide

C : Carbon

S : Silicium

ABBREVIATIONS

HA : Hydroxyapatite

EU : European Union

USA : United States of America

Ti-OH : Titanium hydroxide

Bov. HA : Bovine Hydroxyapatite

β-TCP : β-tricalcium phosphate

TTCP : Tetracalcium phosphate

ACP : Amorphous calcium phosphate

AT : Aluminum titanate

CaP : Calcium phosphate

SEM : Scanning Electron Microscopy

EDS : Energy Dispersive Spectrometry

XRF : X-Ray Fluorescence Spectrometry

XRD : X-Ray Diffraction

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