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SBF 对植入物用多孔钛构件循环压缩性能的影响

Munshi Muhammad Raihan[1], Afrina Khan Piya[1], Mohammad Alamgir Hossain[2,*]
1 日本 新潟 长冈市长冈工业大学机械工程系
2 孟加拉国 达卡 军事科学技术学院机械工程系

摘 要：近年来，多孔结构因其优于块状材料的特性而受到植入物应用研究者的关注。本研究的目的是评估多孔钛部件在模拟体液（SBF）中的循环压缩行为。以复型浸渍法制备的多孔钛构件为研究对象。空气中的压缩试验表明，多孔体的屈服强度平均为 8MPa，弹性模量约为 180MPa，这与松质骨应用兼容。在 10%应变后，多孔结构塑性变形，产生长平台区域。压缩疲劳试验表明，在较高应力水平下，多孔钛在 SBF 中比在空气中更早失效。相比之下，多孔基材的疲劳极限为 2MPa，不受 SBF 介质的影响。在 SBF 中进行 1000 万次循环后，通过 SBF 的再沉淀，在多孔钛表面部分形成磷酸钙层。EDS 分析表明，Ca/P 原子比为 1.44，接近β-TCP 和 HA 相，这些相有利于骨组织向内生长。
关键词：SBF；循环压缩性能；多孔钛；植入物应用；耐腐蚀性；EDS 分析；骨传导率和生物活性涂层

Effect of SBF on Cyclic Compression Behaviour of Porous Titanium Component for Implant Application

Munshi Muhammad Raihan[1], Afrina Khan Piya[1], Mohammad Alamgir Hossain[2,*]
1Department of Mechanical Engineering, Nagaoka University of technology, Nagaoka City, Niigata, Japan
2Department of Mechanical Engineering, Military Institute of Science and Technology, Dhaka, Bangladesh

Abstract: In the recent years, porous structure is being drawn attention to the researcher for implant application for superior characteristics over bulk materials. The aim of this study is to evaluate the cyclic compression behaviour of porous titanium components in simulated body fluid (SBF). Porous titanium component developed by replica impregnation method was taken for study. Compression tests in air revealed that the yield strength of the porous body is 8MPa on average and elastic modulus is around 180MPa which is compatible to cancellous bone application. After 10% strain porous structure deformed plastically producing a long plateau region. Compressive fatigue tests revealed that at higher stress level porous titanium failed earlier in SBF than in air. In contrast, fatigue limit of porous substrate is 2 MPa which was not affected by SBF medium. After 10 million cycles in SBF, Calcium Phosphate layer was partially formed on the surface of porous titanium by re-precipitation from SBF. EDS analysis showed that the Ca/P atomic ratio was 1.44 which is near to beta TCP and HA phase and these phases are beneficial for bone tissue ingrowth.
Keywords: SBF; Cyclic compression behaviour; Porous titanium; Implant application; Corrosion resistance; EDS analysis; Osteoconductivity and bioactive coating

1.引言

110GPa

[1]

3D [2]

100 400 mm

[3-6] SEM EDX HAp HAp/

[7]

[8-13]

SBF

EDS

2.

2.1

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90%
[7] 9mm
9mm
1

Chemical Compositions	Percentage of wt.
Fe	0.033
H	0.006
N	0.009
C	0.005
O	0.113
Ti	Balance

1. wt% [7]

2.2.

30 kN
-1mm/min -5mm PCD-300 50Hz

2.3.SBF

SBF
10Hz 10
10%
0.75 0.5 0.25 1000
SBF
SBF SBF 2
Tadashi Kokubo [14]
MTCS 15-BN SBF 37 ± 1 pH 7.4 SBF

Chemical	Amount (gm)
NaCl	8.035
$NaHCO_3$	0.355
Chemical	**Amount (gm)**
KCl	0.225
$K_2HPO_4.3H_2O$	0.231
$MgCl_2.6H_2O$	0.311
$CaCl_2$	0.292
Na_2SO_4	0.072
Tris	6.118
HCl (mol/L)	39+5

2.1L SBF [13]

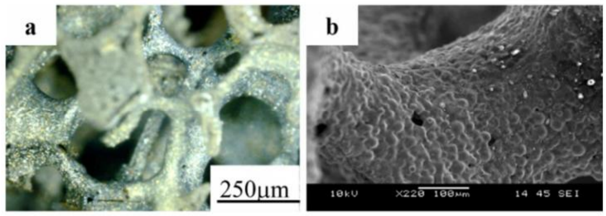
2.4.SEM

VHX-1000
SEM JEOL
JSM-6306A SBF EDS

3.结果和讨论

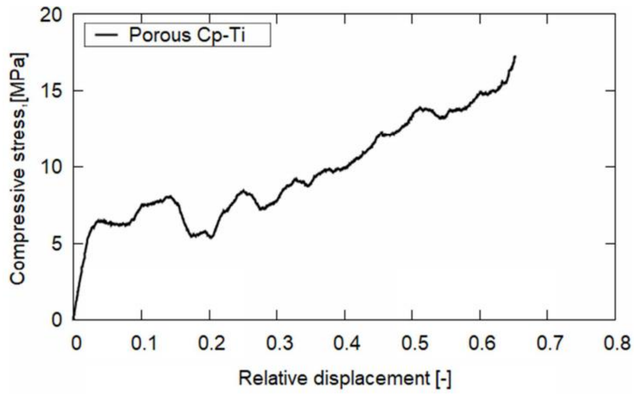
3.1.

1 a
SEM
10-20mm 300-600mm



1. a b SEM

3.2.



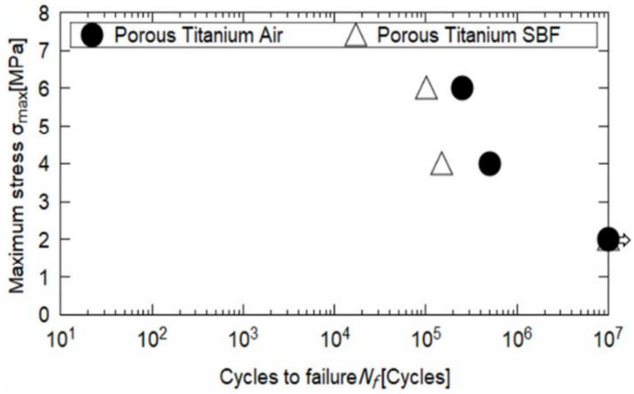
2.

2
0.2% 8MPa
180MPa 100-1000MPa [15]

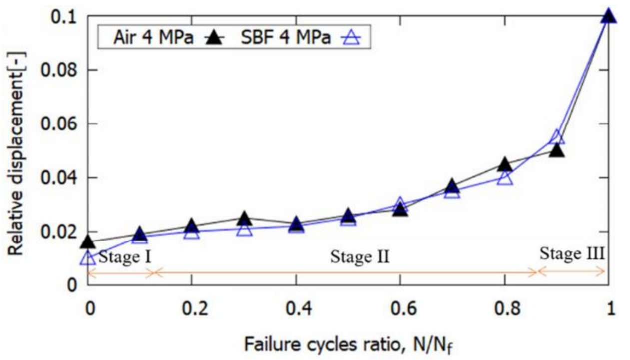
10%
10%

3.3.SBF
S-N 3
SBF
2MPa 4

III
[11]



3. SBF



4. SBF

3.4.SBF SEM

5

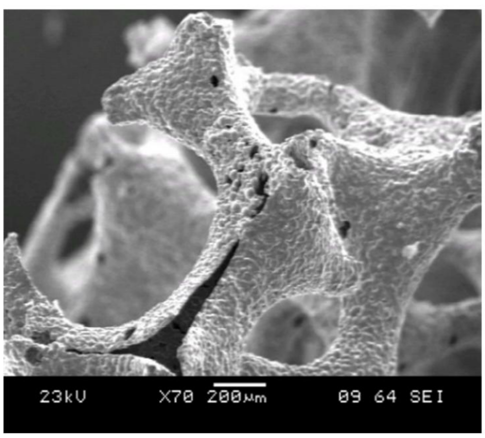
6

7 EDS 8

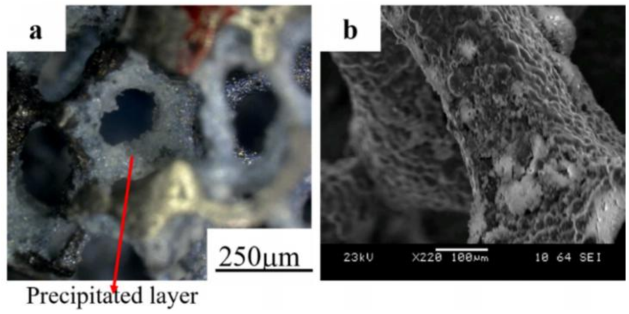
Ca/P

1.44 b-TCP HA

[16]

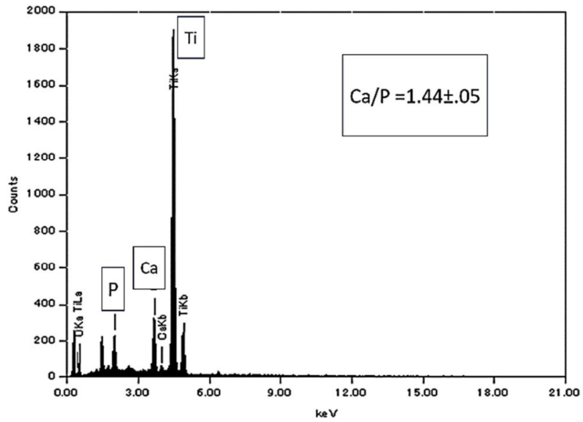


5. SEM

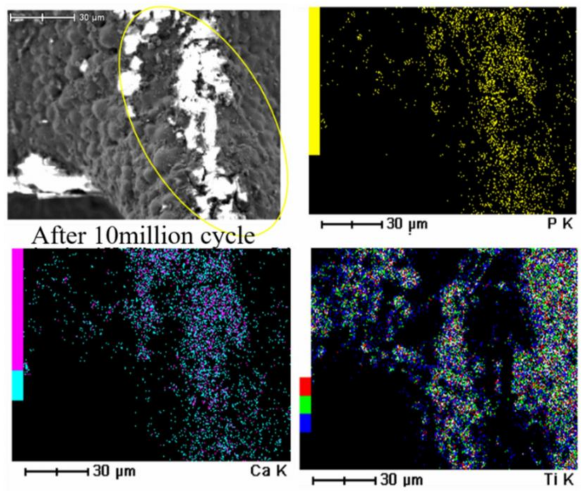


6. SBF 2 MPa a

SEM b



7. 6 b EDS



8. SBF 2MPa Ca P

4.结论

2MPa

SBF SBF

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