Laser irradiation of WE54 surface through simulated body fluid layer

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Introduction

Magnesium and its alloys are promising biomaterials for temporary implant application because of their degradability and biocompatibility [1,2]. The surface morphology, micro-structure, and chemical composition of material are vital for cell adhesion. In this study, laser treatment of WE54 in simulated body fluid (SBF) has been carried out to explore the technique to produce bio-structures through various ion deposition such as Ca/P on WE54 surface so as to improve its surface bio-functionality.

Methods

WE54 was immersed in SBF in a beaker. The immersed height of SBF solution above WE54 sample surface was 2 mm. A 500 watt pulsed Nd: YAG laser, having a wavelength of 1064 nm, frequency of 7000 Hz and pulse duration of 38 ns was used to irradiate WE54 surfaces through SBF. Cell viability test was performed after 3h and 8h of stem cell culture. SEM microscopy was performed to observe WE54 surface.

Objective

- ~ To create bio structures by depositions of calcium and phosphate ions on the surface of WE54
- ~ To improve the surface morphology for bio-engineering applications i.e. Cell viability as an example

Results

Direct laser irradiation under air (left), Laser irradiation under 2 mm SBF layer (right)

- Water molecules were evaporated by laser-induced high energy of plasma in SBF during laser irradiation [3,4]. Remaining supersaturated ions (Ca, P) in SBF are deposited on the WE54 surface

Elemental mapping of laser irradiated through SBF: Red-P and green-Ca ions on the surface. Ca/P ion deposited on the surface during the laser irradiation through SBF

Calcium ion

Phosphorous ion

Improvement in cell viability

Adhered cell layer morphology

SEM micrographs of laser treated with SBF surface after 3h cell culture, different patterns showed

On SBF surfaces with 8h culture, a relatively smoother appearance was observed due to cell layer formation over time.

Conclusion

- Laser treatment through SBF layer has successfully produced the layered surface morphology and active Ca/P ions layer on the WE54 surface. The presence of supersaturated Ca/P ion has led to significant improvement on the cell viability.

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