Enhanced Biocompatibility of PEEK by Ti Coating

Cheol-Min Han, Hyoun-Ee Kim.
Department of Materials Science and Engineering, Seoul National University, Seoul, Korea

Introduction: Since the late 1990s, PEEKs (Poly etheretherketones) have been widely studied as biomaterials for trauma, orthopedic, and spinal implants, and it is considered as substitutes for metallic materials. As implant materials, thermal, chemical stability and high mechanical properties of PEEKs are most important advantages. However, the fixation with bone was limited because of their low biocompatibility. There have been many researches in order to improve biocompatibility of PEEKs. Bioactive coating, such as Ti or HA coating, was proposed as a method of surface modification of PEEK [1]. Also there was preliminary study of Ti coating which reported that after Ti coating, PEEK showed enhanced biocompatibility [2]. However it focused on the clinical cases only. Therefore this study is aimed at the fabrication of surface modified PEEK that has improved biocompatibility through Ti coating using electron beam deposition, with focusing on materials and processing.

Methods: Polished medical grade PEEK (16 mm diameter x 2 mm thickness) and cp grade Ti (10 mm x 10 mm x 1 mm) were used as substrate and target, respectively. PEEK was coated with cp grade Ti with 1 μm by electron beam deposition at a rate of 0.5 nm/s. Phases were investigated by X-ray diffraction patterns. Hydrophilicity of the specimen surface was evaluated by measuring the wetting angle of sessile drop by using a goniometer. Biocompatibility of the specimen was evaluated by in vitro cellular responses.

Results: Figure 1 shows the XRD patterns of (A) PEEK, and (B) Ti coated PEEK. In Figure 1(A), there were some peaks for PEEK. Because crystalline content of PEEK is 30~40 %, it shows relatively sharp peaks. In Figure 1(B), titanium peaks were detected and intensities of peaks of PEEK weakened. According to this XRD pattern, it was confirmed that Ti layer was formed on the PEEK surface. The optical images of sessile drop on the each surface pictured by goniometer are shown in Figure 2. Before Ti coating, the wetting angle was about 75°, and it reduced to 25° after Ti coating. It means that hydrophilicity of the PEEK increased remarkably. SEM images of the MC3T3 cells cultured on the specimens for 3 h are shown in Figure 3. On the PEEK surface, most of cells did not spread yet, as shown in Figure 3(A). On the other hand, on the Ti coated surface, it was found that the cells more widely spreaded, as shown in Figure 3(B).

Conclusions: PEEK was successfully coated with Ti by electron beam deposition. After Ti coating hydrophilicity of PEEK surface increased, and cell attachment behavior was further improved.

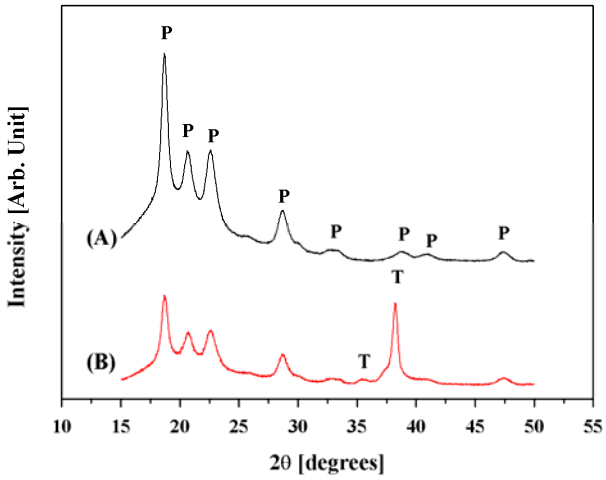

Figure 1. XRD patterns of (A) PEEK, (B) Ti coated PEEK (P: PEEK T: Ti)

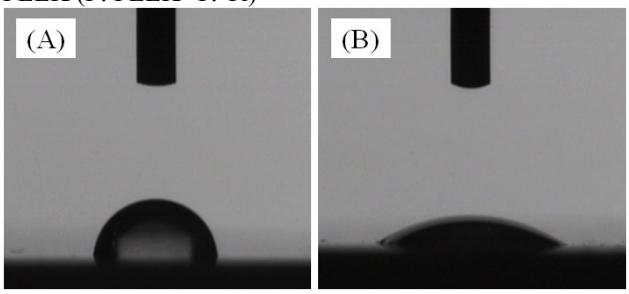

Figure 2. Optical images of sessile drop on the (A) PEEK , (B) Ti coated PEEK surface.

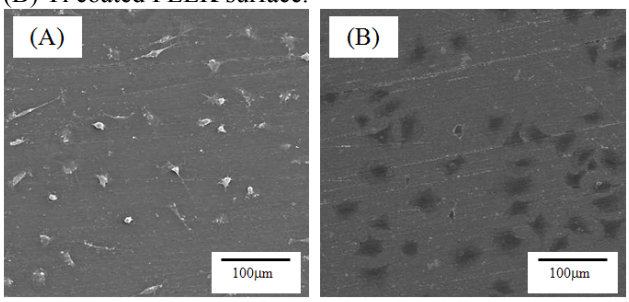

Figure 3. SEM images of MC3T3 cells cultured for 3 hours on (A) PEEK, (B) Ti coated PEEK.

References:

1. Kurtz SM. Biomaterials. 2007; 28, 4845-4869.
2.Cook SD. J Oral Implantol. 1995; 21, 176-181.