PREPARATION OF CALCIUM SILICATE BY LCVD PROCESSING AND EFFECT ON CELL ADHESION

No. 2181214 Rui Ogata
(Supervised by Associate Professor Ai Momozawa)

ABSTRACT

Artificial bone or dental implants are used when bone or teeth are lost due to accident or disease. Titanium is one of the biomaterials used for implants. Titanium is commonly used in clinical practice because of its ability to bond directly to bone. However, it takes a certain period of time to bond directly to bone, during which time there is a concern about the risk of infection from the defect. Therefore, this paper focuses on LCVD processing with the aim of improving cell adhesion by surface processing, which is a process in which raw materials are evaporated and a chemical reaction is accelerated by a laser to form a thin film on a substrate. The calcium silicate produced in this study is available in three types with different composition ratios and has attracted attention as a biomaterial. However, calcium silicate has composition ratios that are difficult to process due to their high melting point, and cell studies with different composition ratios have not been conducted much.

The aim of this study was to prepare thin films of calcium silicate by LCVD processing and to investigate the effects of calcium silicate with different composition ratios on cell adhesion.

Initially, conditions of producing calcium silicate were investigated and, at the same time, the possibility of coating on the metal titanium was examined. Titanium and the ceramic material alumina were used as substrates. As a result of varying the substrate temperature, furnace pressure, laser intensity and material vaporisation temperature, it was found that calcium silicate films could be formed in the LCVD process at a substrate temperature of 700°C or higher and a material molar ratio of 0.2 or higher. Furthermore, calcium silicate films with different composition ratios were deposited by changing the pressure, suggesting that the composition ratio of calcium silicate can be changed by pressure in the LCVD process. Although calcium silicate films could be deposited on titanium, the films tended to peel off from the substrate under high pressure. On the other hand, films on alumina were deposited stably even under high pressure.

Next, culture experiments were conducted to investigate the effect of different composition ratios on osteoblasts. The maximum number of cells after 24 hours was shown with a composition of $CaSiO_3$ and a roughness of 0.390 μm. In addition, it was observed that the cells were placed in adhesive morphology and started to adhere early after 0.5 hours of incubation on composition of $CaSiO_3$. This suggests that the composition ratio of $CaSiO_3$ with a roughness of 0.390 μm may cause cells to adhere earlier.