Preparation of Poly (Lactic Acid) Short Fibers for the Application to Porous Composites

Yoichiro Mizutani
R & D Center, NGK Spark Plug Co., LTD.
yo-mizutani@mg.ngkntk.co.jp

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A nonwoven fiber mesh consisting of biodegradable polymers, such as poly(lactid acid) (PLA), may be one of the best candidates for implants used in the regeneration of damaged tissue, because it has the continuous pore structure, which would allow ingrowth of tissues. [1] In the case of materials for bone regeneration, it is also essential that the materials have biocompatibility with bone tissue. It has been reported that the biodegradable polymers do not have the biocompatibility and it can be improved by addition of hydroxyapatite (HAp:$Ca_{10}(PO_4)_6(OH)_2$), because HAp is the inorganic component of hard tissue and exhibits high biocompatibility. [2]

In the present work our objective is to prepare a porous composite with both of interconnected pore structure and high biocompatibility to be applied to the implants for hard tissue repair. Our approach is to utilize HAp whiskers as a part of frameworks in the PLA fiber mesh. In the approach it is significant to obtain short fibers of PLA, because they are easy to be mixed with HAp whiskers homogeneously. However, in general polymer fibers are obtained by spinning technique and they are continuous fibers. [3] We developed a new method using an emulsion technique for the preparation of PLA short fibers as shown in figure 1; PLA solution (methylene chloride) were drop-wise added to a poly (vinyl alcohol) solution including a coagulation agent with stirring to complete evaporation of the solvent and PLA were precipitated in the solution. A porous material was prepared by mixing the PLA short fibers and HAp whiskers obtained by a hydrothermal treatment [4, 5], filling them to a mold and sintering them at around melting temperature of PLA. Figure 2 shows SEM images of a porous composite prepared using PLA short fibers and HAp whiskers. They indicate that PLA short fibers bond the adjacent PLA short fibers and HAp whiskers by softening of the PLA during heat treatment. The bonding of them forms the continuous large-sized pores. The average pore diameter is 20 μm and the composite has a large porosity of 80%. The composite is also expected to have high biocompatibility, because there exist HAp whiskers as a part of framework in the material or on the surface of PLA so that most surfaces of HAp are exposed. The PLA short fibers

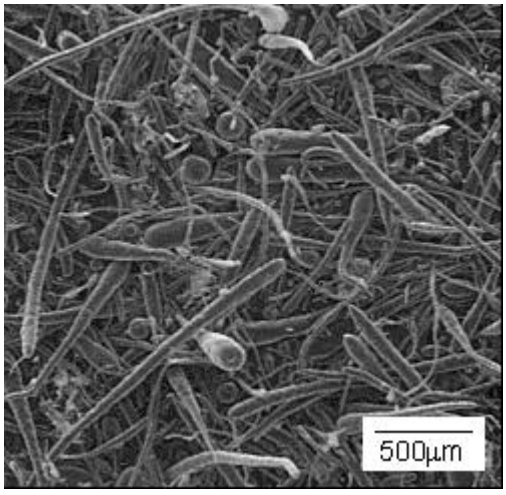

Fig. 1 SEM images of PLA short fibers.

are believed to be significant for fabrication of a porous composite with both of an excellent continuous pore structure and high biocompatibility suitable for the biomaterials, such as a bone filler or a bone tissue engineering scaffold.

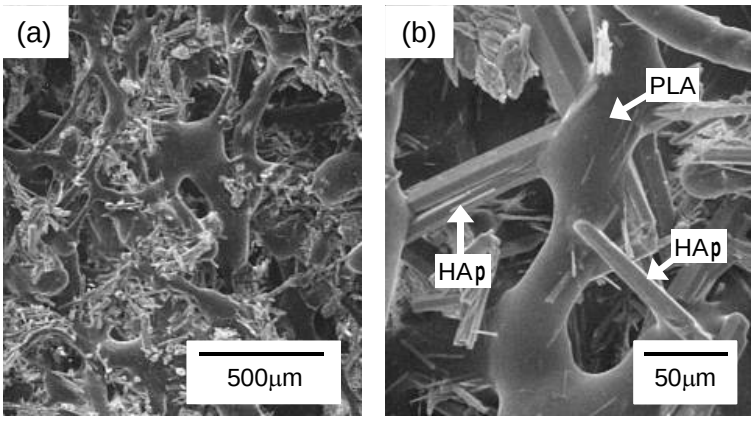

Fig. 2 SEM images of HAp / PLA porous composite.
(b) is the highly magnified image.

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Biographical Sketch

Name : Yoichiro Mizutani

Born : February 06, 1972

Home town : Aichi, Japan

Nationality : Japanese

Degree : Ph. D (Nagoya Institute of Technology, Japan)

Study : Biomaterials

Affiliation : R & D Center, NGK Spark Plug Co., LTD.
2808 Iwasaki, Komaki, Aichi 485-8510, Japan.
Tel: 81(568) 76-1543, Fax: 81(568)76-1295
E-mail: yo-mizutani@mg.ngkntk.co.jp
Web: http://www.ngkntk.co.jp/