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Environmentally Friendly Preparation of Functional Nanomaterials and Their Application

SunHyung Lee†, Katsuya Teshima, Morinobu Endo, Shuji Oishi

Shinshu University
(leesh@shinshu-u.ac.jp†)

One of the most important environmental problems is global warming. Global warming is caused by increase in the amounts of water vapor, methane, carbon dioxide and other gases being released into the atmosphere as a result of the burning of fossil fuels. It has thus become important to reduce fossil fuel use. Environmentally friendly preparation of functional materials has, therefore, attracted much interest for environmental problems. Furthermore, nature mimetic processes are recently been of great interest as environmentally friendly one. There have been many studies on fabrication of various functional nanocrystals. Among various nanocrystal fabrication techniques, flux growth is an environmentally friendly, very convenient process and can produce functional nanocrystals at temperatures below the melting points of the solutes. Furthermore, this technique is suitable for the synthesis of crystals having an enhedral habit. In flux growth, the constituents of the materials to be crystallized are dissolved in a suitable flux (solvent) and crystal growth occurs as the solution becomes critically supersaturated. The supersaturation is attained by cooling the solution, by evaporation of the solvent or by a transport process in which the solute is made to flow from a hotter to a cooler region.

Many kinds of oxide nanocrystals have been grown in our laboratory. For example, zero- (e.g., particle), one- (e.g., whisker and tube) and two-dimensional (e.g., sheet) nanocrystals were successfully grown by flux method. Our flux-growth technique has some industrial and ecological merits because the nanocrystal fabrication temperatures are far below their melting points and because the used reagents are less harmless to human being and the environment.

Keywords: Functional crystal, Dry process, Flux method, Inorganic material, Carbon material

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치과용 생체세라믹스의 강화

공영민†

울산대학교 공과대학 첨단소재공학부
(longmin2@ulsan.ac.kr†)

인체 경조직인 뼈와 치아는 콜라겐 단백질과 인산칼슘 무기질 성분으로 구성된 최적의 복합체라 볼 수 있다. 이러한 인산칼슘 무기질 성분은 결정학적, 화학적으로 hydroxyapatite (HA, Ca10(PO4)6(OH)2)와 거의 유사하여 높은 생체활성과 골전도성을 보이는 것으로 알려져 있다. 또한, hydroxyapatite의 고온 분해 산물로 볼 수 있는 tricalcuim phosphate (TCP, Ca3(PO4)2)는 체내에 이식시 체액에 용해되어 신생골을 유도하는 생체흡수성 세라믹스로 알려져있다. 이러한 HA와 TCP는 우수한 생체친화성에도 불구하고 기계적 특성이 낮아, non-load bearing 부위에 적용이 되어 다공질의 골수복재 용도로 활용되거나, load-bearing부위의 적용을 위한 금속 implant 등의 생체친화성 보완을 위한 표면 코팅재로 사용되고 있는 실정이다.

본 발표에서는 생체특성이 매우 우수한 인산칼슘 생체세라믹스의 load-bearing part 적용을 위하여 강도 및 파괴인성의 기계적 특성을 증진시킨 사례를 살펴보고, non-load bearing part에 실제 사용되는 인산칼슘 생체세라믹스의 다공질(porous) 골수복재(bone graft)의 역학 특성 증진을 위한 아이디어와 함께, 역학 특성이 매우 뛰어난 지르코니아 생체세라믹스의 강화-소결법에 대하여 소개하고자 한다.

Keywords: 생체세라믹스,강도,수산화아파타이트,지르코니아,알루미나