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Inflammatory molecular signaling and biomineralization ability of bioactive dental materials

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Mineral trioxide aggregate (MTA) and Biodentine have been shown to be bioactive because of its ability to produce biologically compatible carbonated apatite. These cements release some of their components in phosphate-containing fluid, triggering the initial precipitation of amorphous calcium phosphates, which act as precursors for the formation of carbonated apatite. This spontaneous precipitation promotes a biomineralization process that leads to the formation of an interfacial layer with Tag-like-structures at the cement-dentin interface. The ability to induce the formation of apatite allows the integration of the biomaterial into the environment. However, host responses to biomaterials are dependent on the innate and nonspecific immune responses that occur in the surrounding tissues. Our studies provide compelling evidence of the in vivo biomineralization process promoted by MTA. SEM analysis showed the deposition of apatite-like clusters on collagen fibrils at 12h after implantation. SEM-EDAX indicated that the precipitates were mainly composed of calcium and phosphorus. To our knowledge, our studies are the first to provide evidence that the biomineralization process occurs simultaneously with the initial acute inflammatory response. MTA induced the activation of NF-kB signaling system at the early stage of inflammation. This finding can be associated with a proinflammatory and pro–wound-healing environment. Therefore, we hypothesize that together with the alkalinity of the material, the precipitation of apatite by biomaterials during the acute phase of inflammation may induce changes in gene expression and subsequently in cell functional activity. These changes are likely to stimulate repair, wound healing and dentinogenesis or cementogenesis.

Biography

Reyes Carmona has completed his Ph.D at the age of 30 years from UFSC, Brazil and is going to initiate postdoctoral studies in the Angiogenesis Laboratory of the Dentistry School, University of Michigan. She is the director of the Laboratory of Research at University of Costa Rica. She has published more than 12 papers in reputed dental journals, as Journal of Endodontics, International Endodontic Journal, Journal of Pediatric Dentistry and Dental Traumatology.

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Template-Free hydrothermal synthesis of mesoporous MgO nanostructures and their application in water treatment

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The unique size and shape-dependent properties of nanomaterials have simulated many investigators to develop more simple and inexpensive routes to fabricate morphology controllable nanomaterials. Herein, we demonstrate an environmentally benign route to synthesize the $Mg(OH)_2$ nanostructures with morphologies of nanowires and microflowers composed of nanoplates based on the simple hydrolysis reaction of $Mg(CH_3COO)_2$, without using any additives, surfactants and substrates. It is found that the reaction medium has played a crucial role in the morphological tailoring of the nanostructures of the precursor. The high polarity of water molecules favors the polar growth of the precursor, resulting in the formation of nanowires with a diameter of 80 nm, whereas a mixed water-ethanol medium with lower degree of polarity leads to the formation of microflowers. Moreover, the $Mg(OH)_2$ (brucite) could be transformed to MgO (periclase) by heat treatment via a topotactic transformation. After thermal treatment, the wire-like and flower-like morphologies could be maintained, except the formation of porosity, which is due to thermal decomposition of $Mg(OH)_2$ and releasing of H_2O. Both the mesoporous MgO nanowires and microflowers show superior ability of adsorbing organic dye in the polluted water treatment.

Biography

Jiabiao Lian has obtained his master degree from Nankai University in 2010. He is pursuing his Ph.D. in Materials Science and Engineering at the Chinese University of Hong Kong as a recipient of the Hong Kong PhD Fellowship. His research interests focus on the morphology controllable synthesis and characterization of oxides functional nanomaterials as well as their related applications. He has spoken at the 2011 North American Solid State Chemistry Conference at McMaster University (Canada) and has published more than 5 papers in some reputed journals, such as ACS Nano and Chemical Communications.

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