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NEWSLETTER
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Production of High Quality Bio-HA with Natural Structure from Bovine Bone

Human hard tissues are natural composites which comprise of nano hydroxyapatite (HA) rods (typically smaller than 100 nm) and protein. Operative treatment to replace bone that is lost due to accident/injury and/or bone defects resulting from inflammatory or chronic diseases has remained a challenge for orthopaedic surgeons. Due to the limited supply of natural bone for grafting, the need for bone substitutes which has the same physicochemical and biological properties as natural bone is ever increasing. Although autogenous bone is most preferred for the treatment of bone defects, there are disadvantages and risks involved in using autogenic bone such as post-operation pain, increased blood loss, secondary surgical wounds and risk of thrombosis. Additionally, only a limited quantity of autogenous bone graft is available for harvest from a patient at any one time and this can be insufficient for children as well as adults requiring revision surgery. Allograft bone could overcome the above limitations, but it bears the risk of transmission of infection (e.g. HIV, Hepatitis, etc.). Despite all of this, and amid concerns about its safety, the use of allogenous bone graft for skeletal restoration has been generally accepted and will likely to continue until alternative methods are found. Another possible alternative for treatment of bone defects is the use of xenogenous bones, which is morphologically and structurally similar to human bone.

Thus, in this invention, bovine bone is selected for this research with different aspect and point of view such as human health care, public health and clean environment. Bovine bone is a waste material which has no value in its original state and the disposal of such material can pose serious risk to public health, contamination of water resources and the environment. At the material level, bovine bone is composed of organic and inorganic components. The organic part contains mainly collagen and proteins, whereas the inorganic component is mainly hydroxyapatite (HA) with small percentage of other elements being present such as carbonate, magnesium and sodium.

In this invention, calcium phosphate hydroxyapatite was successfully extracted from bovine bone. The material derived from this invention composed of phase pure HA, having structural properties close to human bone. This HA is subsequently tailored to exhibit exceptional mechanical properties coupled with fine microstructure (Table 1 and Figure 1). This new Bio-HA has great potential to meet the growing demand for artificial bone-like material for maxillofacial surgery, as solid implants for orthopaedics application, as bone graft substitution and as biocompatible coatings on metallic implants.

Prof Ramesh and team members receiving the JIPA award from the representative from MTE 2014

Awards

Japan Intellectual Property Association (JIPA) Award for Best Biotechnology Invention
In conjunction with the Malaysia Technology Expo 2014: Invention & Innovation Competition (MTE2014)

Gold
The Malaysia Technology Expo 2014: Invention & Innovation Competition (MTE2014)

Gold
The 24th International Invention, Innovation & Technology Exhibition 2013 (ITEX 2013)

Double Gold Medal (Special Award)
The British Invention Show 2007 (BIS), London, United Kingdom

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Significant Properties	Human thigh bone	Bio-HA
Density (g/cm3)	1.6 - 1.7	3.02
Fracture Toughness (MPam 1/2)	1 - 1.5	1.84
Hardness (GPa)	0.48 – 0.98	2.95

Table 1. Mechanical properties of Bio-HA

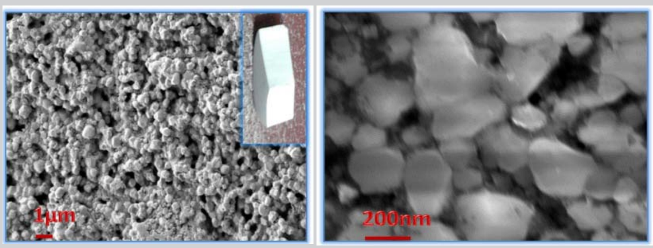

Figure 1. Fine microstructure of Bio-HA

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Optical Fiber based Radiation Dosimeter

Next Generation Dosimeter Sensor

Ionizing radiation is radiation with enough energy so that during an interaction with an atom, it can remove tightly bound electrons from their orbits, causing the atom to become charged or ionized. Radiation dosimetry is the measurement and calculation of the radiation dose received by matter and tissue resulting from the exposure to ionizing radiation. Ionizing radiation dosimetry has worldwide demand/ market due to its crucial and wide range of applications such as personal monitoring, radiology and radiotherapy based treatments for cancers/ tumors, food/spice and surgical tools sterilization, nuclear association industries and etc (Figure 1).

There are different types of dosimeter sensors that can be used to measure and monitor the amount of dose delivered by the radiation to the human body/tissue, object, or environment. However,each sensor is designed for a specific range of dose measurement to perform correctly. This makes each sensor to be used in a limited applications.

Glass based optical fibers have shown great potential to be used as ionizing radiation dosimeter. Recently, a novel and versatile microstructured based optical fiber is designed and fabricated by Photonic Research Group (PRG) in University of Malaya that breakthrough the dosimeter sensors technology (Figure 2). This method is based on fusing wall-surface of hundreds of fine-capillary fibers during drawing process. The proposed method is used to fabricate undoped- and doped-optical fibers, where they could improve radiation dose sensitivity more than 15 and 45 times compared to the original fiber, respectively.

The designed optical fibers are examined in medical and industrialapplications. Compared to the commercially available sensors, the proposed fibers support significantly wider range of doses from micro to Mega-Gray with high- and linear-sensitivity. Furthermore, the optical fibers have other advantages including higher spatial resolution, higher sensitivity, and providing both real time and offline monitoring services. It is important to note that optical fiber is compatible with the commercially available measurement systems/ machines without requiring any modification. These advantages plus the amazingly low cost of optical fiber per dosimeter sample (i.e., <RM0.01) made this material very interesting for the dosimeter industry as the next generation dosimeter material.

In terms of marketability, considering only the personal monitoring application in Malaysia where there are 21,000 registered workers associated with radiation, it can save more than RM 12.4 million by replacing their current sensors with optical fiber.

Awards

Gold
Malaysian Technology Expo (MTE 2014)

Silver
i-INOVA 2013

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Figure 1. Dosimeter applications.

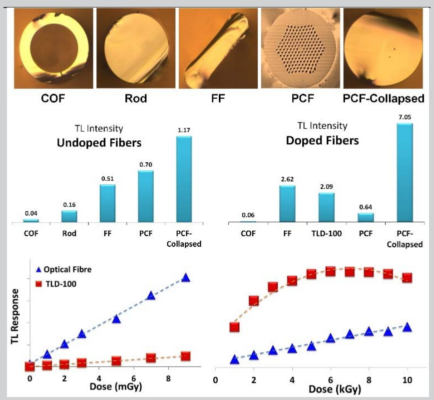

Figure 2. New optical fibers and their dose sensitivity response