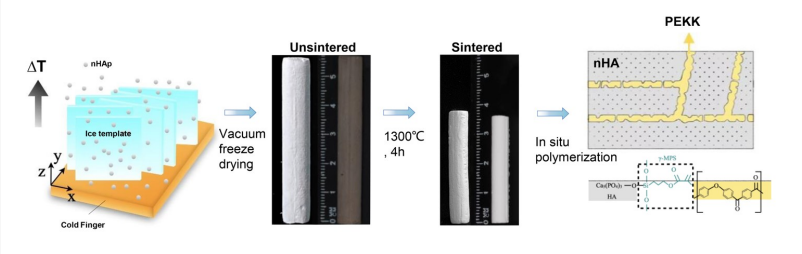
Fabrication of the PEKK-reinforced nano-HA composites inspired by the cortical bone

USA, April 24, 2024 /EINPresswire.com/ -- In a ground-breaking first, researchers created scaffolds with enhanced strength by fabricating 20 vol% polydopamine-modified nano hydroxyapatite (pDA-nHA), featuring a distinctive lamellar structure. These scaffolds were then immersed in a polyetherketoneketone (PEKK) synthesis system for reinforcement, offering an innovative approach to both augment the mechanical robustness of the material and enhance the bioactivity of PEKK.



Graphic abstract.

Nano hydroxyapatite (nHA), the primary inorganic component of bone widely utilized in bone tissue engineering, suffers from poor mechanical properties when used alone. Conversely, polyetherketoneketone (PEKK), a high-performance polymer approved by the US Food and Drug Administration (FDA) and used in dentistry and biomaterial science, struggles with bioinertia, affecting its osteogenesis applications.

In a study (doi: https://doi.org/10.1016/j.supmat.2023.100062) published in the KeAi journal Supramolecular Materials, researchers from Sichuan University, China, introduced pDA-nHA/PEKK composites that combine high strength and bioactivity.

“The optimal combination of nHA and PEKK can achieve higher mechanical property and bioactivity,” shares lead author Zhongyi Wang. “Nevertheless, conventional melt blending techniques often result in weakened strength due to nanoparticle agglomeration and the lack of chemical bonds between the inorganic and organic constituents."

To that end, the team drew inspiration from the structure of cortical bone. By employing freeze-casting technology, the researchers mimicked the bone's hierarchical structure, which is known for its exceptional stiffness and toughness. This technique allowed them to produce complex hierarchical materials. The novel approach, characterized by the in-situ polymerization of PEKK, resulted in the development of pDA-nHA scaffolds with enhanced osteo-inductive abilities and supplemented mechanical strength through PEKK.

Corresponding Haiyang Yu highlighted this development as an advancement in supramolecular materials, surpassing the strength capabilities of current methods. Yu hopes their approach to hierarchical architecture and in-situ polymerization will inspire further scientific discoveries.

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