

Preparation of 3D printed silicon nitride bioceramics by microwave sintering

ABSTRACT

Silicon nitride (Si_3N_4) is a bioceramic material with potential applications. Customization and high reliability are the foundation for the widespread application of Si_3N_4 bioceramics. This study constructed a new microwave heating structure and successfully prepared 3D printed dense Si_3N_4 materials, overcoming the adverse effects of a large amount of 3D printed organic forming agents on degreasing and sintering processes, further improving the comprehensive performance of Si_3N_4 materials. Compared with control materials, the 3D printed Si_3N_4 materials by microwave sintering have the best mechanical performance: bending strength is 928 MPa, fracture toughness is $9.61 \text{ MPa}\cdot\text{m}^{1/2}$. Meanwhile, it has the best biocompatibility and antibacterial properties, and cells exhibit the best activity on the material surface. Research has shown that the excellent mechanical performance and biological activity of materials are mainly related to the high-quality degreasing, high cleanliness sintering environment, and high-quality liquid-phase sintering of materials in microwave environments.