Newly Developed Lithium DiSilicate Based Glass- Ceramics for 3D Printable Artificial Bones

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In recent years, there has been an increasing interest in porous fabricated biomaterials that can be fabricated in three dimensions in order to remove hard tissue damage and strengthen tissues[1]. Designed for this purpose, bioactive glass-ceramics are specialized biomaterials, which form strong bonds by reacting with tissues and / or bones[2]. Glass-ceramics containing lithium disilicate are an important milestone in the use of bioactive glass-ceramics as an implant. Lithium disilicate (LiS2) glass-ceramics have superior aesthetic and optical properties, high bending strength (300-400 MPa) and high fracture toughness (2.8-3.5 $MPa.m^{1/2}$) [3]. These properties, which are superior to other bioactive glass-ceramics, are thought to serve as a skeleton for the formation of new bone tissue and can be used instead of damaged bone tissue.

There are various methods for the production of LiS2 glass ceramics. Commonly used are classical melting method and sol-gel method. In classical melting process, the formation of a fine-grained microstructure is accompanied by an increase in strength and wear resistance[4]. However, there are limitations to the use of this method due to the evaporation of volatile oxides at high temperatures. In sol-gel method, glass porosity can be controlled at low temperatures and glass materials having a much more homogeneous structure than glass produced by the conventional method can be produced. In recent years, with the development of technology, bioactive glass-ceramics production is being done by using 3D printer which is computer aided design and production method. The purpose of the present study is to develop a LiS2 glass-ceramic based system for 3D printing applications of artificial bones.

References

1. Mallick K., 2009. ‘‘Freeze Casting of Porous Bioactive Glass and Bioceramics’’, J. Am. Ceram. Soc., 92 [S1] S85–S94.

2. Kükürtçü B., ‘‘Biyoaktif Cam ve Cam-Seramik Malzemelerin Üretimi ve Yapay Vücut Sıvısı İçerisindeki Davranımlarının İncelenmesi’’, Yüksek Lisans Tezi, İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, İstanbul.

3. El-Meliegy E., van Noort R.,2012 ‘‘Glasses and Glass Ceramics for Medical Applications’’, Springer Science Business Media, LLC.

4. McMillan, P.W., 1979. ‘‘Glass-Ceramics’’, Second Edition, Academic Pres, London.

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