INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

Name of the Student	:	Nitu
Roll Number	:	176121023
Programme of Study	:	Ph.D.

Thesis Title: Development of sol-gel derived bioactive glass-ceramics for bone regeneration and hyperthermia applications

Name of Thesis Supervisor(s)	:	Prof. A. Srinivasan
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SHORT ABSTRACT

Bioglass and glass-ceramics play a crucial role in regenerative medicine by facilitating bone regeneration and tissue engineering applications. Despite its invention over 50 years ago, 45S5 bioglass remains the benchmark for bioactive materials. However, maintaining its vitreous state in sol-gel-derived nanopowders remains a challenge. This work systematically investigates the effect of Na_2O content on the vitreous state and bioactivity of sol-gel-derived 45S5 compositions. The findings confirm that complete retention of the vitreous state is not feasible through the sol-gel route, shifting the focus to glass-ceramics while preserving high bioactivity. To develop an efficient thermoseed for magnetic hyperthermia, iron oxide and magnetic nanoparticles (MNPs) were incorporated into 45S5 glass-ceramics. While direct iron oxide substitution was cytotoxic above 10 wt.%, MNP-substituted glass-ceramics exhibited improved magnetic properties without compromising bioactivity. The optimal combination of bioactivity and induction heating performance was achieved when MNPs substituted CaO. A systematic heat treatment further optimized the material's properties, yielding a thermoseed with superior performance compared to FluidMag-CT. This study provides new insights into sol-gel-derived 45S5 ceramics, including phase evolution, bioactivity, and magnetism, offering a significant advancement in bioactive and magnetic glass-ceramics.