

CSIR-CENTRAL GLASS & CERAMIC RESEARCH INSTITUTE (CSIR-CGCRI)

BUSINESS DEVELOPMENT & PUBLICATION DIVISION

- i. **Name of Technology:** Multifunctional Borosilicate Bioactive Glass Compositions with Enhanced Thermal Stability, Antibacterial Efficacy, and Bioactivity for Biomedical Applications
- ii. **Details of technology:**

Abstract:

The developed technology presents novel borosilicate based bioactive glass formulations designed to provide an optimal combination of high thermal stability, enhanced antibacterial efficacy, and moderate to good apatite-forming ability compared to widely used commercial bioactive glasses such as 45S5 and S53P4. These key functional properties make it suitable for orthopaedics, bone grafting, dentistry, implant coating and other potential biomedical applications. The evaluated properties of the developed glasses demonstrate high thermal stability ($>145^{\circ}\text{C}$), rapid in vitro bioactivity (24–72 h), and a linear thermal expansion coefficient ($8.5\text{--}9.0 \times 10^{-6}/^{\circ}\text{C}$). The developed glass compositions remain thermally stable during processing and sintering, preventing undesired crystallization and ensuring reliable performance unlike commercially available 45S5 or S53P4 glasses. Owing to their novel composition, superior antibacterial activity, robust thermal stability, and compatibility with scalable processing techniques, these glasses are commercially competitive and suitable for large-scale manufacturing of saleable biomedical products.

Deliverables:

Through this technology, CSIR-CGCRI can provide:

1. **Optimized Bioactive Glass Composition:**
A set of novel borosilicate-based bioactive glass formulations exhibiting high bioactivity, thermal stability, and enhanced antibacterial efficacy comparable to or better than conventional 45S5 bioactive glass.
 2. **Performance-Validated Material:**
Experimentally demonstrated rapid in-vitro bioactivity (24–72 h), high thermal stability ($>145^{\circ}\text{C}$), and compatible thermal expansion ($8.5\text{--}9.0 \times 10^{-6}/^{\circ}\text{C}$) improved osseointegration.
 3. **Technology Know-how:**
A comprehensive technology transfer package including composition details of the bioactive glasses, process parameters and characterization data to facilitate industrial scale-up and adoption by implant manufacturers and biomedical device industries.
- iii. **Year of Development:** 2020-2023
 - iv. **TRL:** 4 (Technology validated in a laboratory environment)

v. Patenting Status:

Patented application is filed (India and WO)

Anustup Chakraborty, Subhadip Bodhak, Kaushik Biswas, "Novel borosilicate based bioactive glass for coating on Ti-6Al-4V implants and its Process Thereof", Indian Patent, Application No. 202311070421, Application date: 16.10.2023; WO Patent Application No. PCT/IN2024/052069, Application date: 15/10/2024; Assignee: CSIR.

vi. Whether already licensed: Not Yet

vii. If so, details of licensing: N.A.

viii. Project under which the technology has been developed: CSIR Major Lab Projects -MLP0108

ix. Name of the nodal scientist submitting EOI: Dr. Kaushik Biswas, Sr. Pr. Sct., SGD, CSIR-CGCRI and Dr. Subhadip Bodhak, Pr. Scientist, BMDD, CSIR-CGCRI