IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

A METHOD OF PREPARATION OF SCAFFOLD WITH VARYING PORE SIZE AND POROSITY AS BONE REPLACEMENTS

IITM Technology Available for Licensing

PROBLEM STATEMENT

- The demand for **synthetic bone substitutes** is **increasing** due to aging, sports, and accidents.
- Resorbable **bone replacements have limitations** due to their **inherent strength limitations.**
- Research **focuses on efficient and economical bone implant fabrication**, aiming to make implants biofriendly and economical.
- Techniques like **gas forming, particulate leaching, phase separation**, and freeze casting are used.
- **Porous implants are found** to be more cost-effective and body-friendly, and the **biomedical industries** are **seeking** a reliable and cost-effective **method for manufacturing porous scaffolds.**
- The **main challenge in particular** is **making the implant as porous as in a bone structure** so that the implant thus made is biofriendly and economical.

TECHNOLOGY CATEGORY/ MARKET

Technology: Preparation of Scaffold with Varying Pore size
Category: Advanced Materials/Additive manufacturing
Industry: Casting/Biomedical industry
Application: Fabricate bone like structures
Market: The global market size of bone substitutes is estimated to be **$124-154 billion by 2023** with the **CAGR of 6.3% from the year 2017.**

INTELLECTUAL PROPERTY

IITM IDF Ref. 1867
Patent No: IN 505180

TRL (Technology Readiness Level)

TRL-4, Experimentally validated in Lab;

Research Lab

Prof. Soundarapandian S,
Dept. of Mechanical Engineering.

TECHNOLOGY

- A **method for the preparation of a scaffold** of **varying pore size and porosity as bone replacement** comprising of
- **Preparing a solid holding** of primary material with
  - ✓ The bio-adaptable material and
  - ✓ A freezing vehicle;
- **Loading of the primary material** in a mould wherein
  - ✓ A **base is provided** with thermal conductive materials **K1 and K2** of varying thermal conductivity;
- **Freeze casting** of the primary material, followed by deep freezing;
- **Sublimating** the demoulded material for **24 hours at 25 °C to form scaffold sintering** the scaffold in a muffle furnace with variable **heating and cooling rate of 5-10 °C/min**; and
- wherein the **porosity of the scaffold differs at the centre to the periphery.**

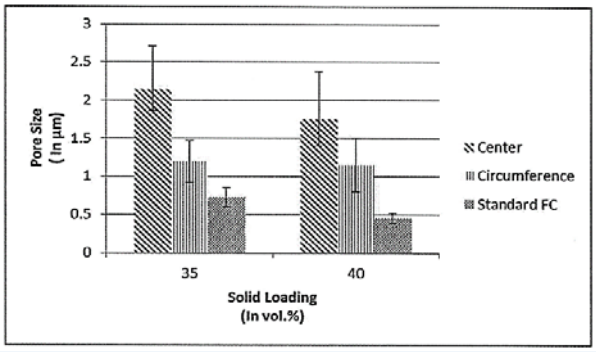

Figure 1 shows the **comparison of pore sizes** of **scaffold fabricated** at **different solid loadings**, regions and freeze casting methods.

CONTACT US
Dr. Dara Ajay, Head TTO
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719

IIT MADRAS
Indian Institute of Technology Madras

Technology Transfer Office
TTO – IPM Cell

Industrial Consultancy & Sponsored Research (IC&SR)

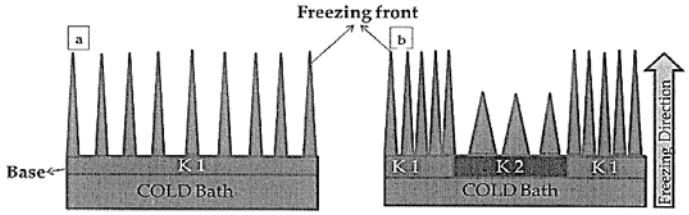

Figure 2 depicts
(a) Conventional freeze casting process with base or cold finger of uniform thermal conductivity (K1)
(b) modified freeze casting process with variable thermal conductivity base (K1 and K2), where K1 > K2.

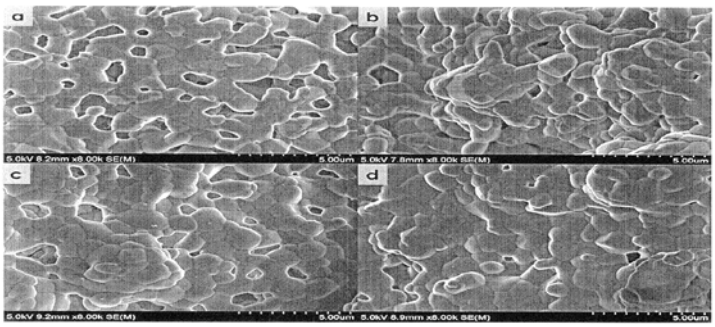

Figure 4 is the photomicrograph of the SEM Pore microstructure at the solid loading of 35 vol.% (a) Center
(b) periphery and 40 vol.%
(c) Center
(d) periphery

Key Features / Value Proposition

- Porous scaffolds with **variable porosity** and pore size at **desired location.** using
  - ✓ **Freeze casting**, mimicking **bone-like** structures.
- Bio-adaptable material is **selected from metals, ceramics and polymers**.
  - ✓ **Metal** is one of titanium, cobalt,chromium alloy, or biograde stainless steel
  - ✓ **Ceramic** is one of tricalcium phosphate, bioglass or alumina
  - ✓ **Polymer** is one of Polylactic acid (PLA),
- **Thermal conductivity**
  - ✓ Material **K1** is preferably **Aluminium**.
  - ✓ Material **K2** is preferably **kapton tape**
  - ✓ **K1>K2.**
- **Pore size** of the scaffold
  - ✓ **Range** of **1µm to 2.5 µm**.
  - ✓ At the **Center** is in the range of **1.75 µm to 2.5 µm**.
  - ✓ At the **Periphery** is in the range of **1µm- 1.5 µm**
- **Primary material**
  - ✓ solid holding **30-40 %** of the total slurry
  - ✓ Mixing of the primary material is at a temperature of **55 °C - 60 °C for 2.5 to 3 hours**
- **Freezing vehicle** is **camphene.**
  - **freeze casting** of the material is 5 at **-5 °C to -15 °C for 20-30 minutes.**
  - **deep freezing** of the material is at **-15 °C to -25 °C for 20-30 minutes.**
- **Tissue regeneration**,
  - ✓ Create a porous and **strong scaffold for osseous tissue regeneration**,
  - ✓ Allowing **new cells to grow** and **penetrate surrounding tissues.**
- Promotes **rapid bone growth**
- **Prevents crushing** during **integration and healing.**
- Manufacturing orthopedic implants at **low cost**.

CONTACT US
Dr. Dara Ajay, Head TTO
Technology Transfer Office,
IPM Cell- IC&SR, IIT Madras

IITM TTO Website:
https://ipm.icsr.in/ipm/

Email: smipm-icsr@icsrpis.iitm.ac.in
sm-marketing@imail.iitm.ac.in
Phone: +91-44-2257 9756/ 9719