

Novel fabrication Method and application for Functionally-Graded Tissue Engineering/Controlled drug Release Scaffolds

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Tissue engineering overview

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Functional grading - tissues

A: 3-D view of human cartilage
B, C, D: 2-D slices from A
E: Cell nuclei for cut C
F: Cellularity as a function of depth

Three-dimensional histomorphometric analysis of normal adult human articular cartilage and bone.

Novel fabrication method (invention disclosure in preparation)

Multiple unit operations:

- Melting
- Pressurization
- Temperature control
- Distributive and dispersive mixing
- Shaping

② Novel co-extrusion die

Cells/proteins

Mathematical modelling & simulation

① Needle apparatus and mini slit die assembly for opening microchannels

Possible Applications

- Ability to generate functionally graded scaffolds for better mimicking of the complex elegance of the native tissues.
- Allow for incorporation of various additives (e.g. nanoparticles, growth factors, drugs)
- Identified major market opportunities for use of scaffolding in tissue engineering
 - Skin healing (e.g. burns, wounds and ulcers)
 - Orthopedics (e.g. bone and cartilage)
 - Organs (e.g. bladder, liver and pancreas)
 - Cardiovascular repair (e.g. heart muscles and veins)

Tissue engineering market

- 1995 – 2001: net spending grew from \$246 million to \$577 million, at a rate of 16% per year
 - The Pittsburgh Tissue Engineering Initiative (PTEI) predicts
 - \$15 billion market for tissue engineered products within 10 years
 - \$80 billion total market potential
 - 24% per annum growth rate of expenditures
 - \$2.5 billion market capitalization
 - Over 47 million procedures per annum benefiting from tissue-engineered products in the U.S. alone
 - 21.9 million by 2010

Advantages of this Research

- **For Commercialization**
 - Suitability for commercial manufacture: **scalability and reproducibility**
 - Lack of a comparable method for tissue engineering and controlled drug/protein release

✓ *One of the few methods available for large scale manufacturing of biodegradable scaffolds for tissue engineering and controlled drug/protein release.*