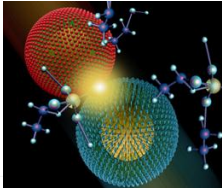


Collaborative Engineering

Biomaterials



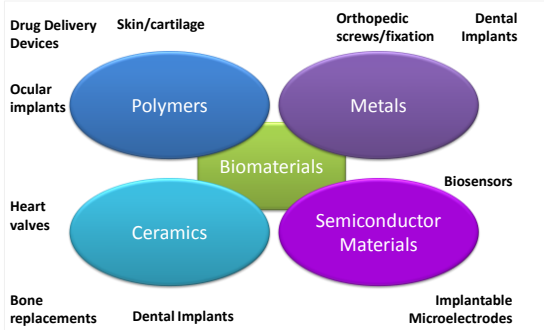
- Biomaterials
- Examples
- Applications
- Evolution

OrthoCAD Lab, I.I.T. Bombay

Introduction

- **Biomaterial:** any matter, surface, or construct that interacts with biological systems
- Often used and/or adapted for a medical application, and thus comprises whole or part of a biomedical device which performs, augments, or replaces a natural function
- **Biocompatibility:** The ability of a material to perform with an appropriate host response in a specific application
- **Applications:** Orthopedics, Dentistry, Ophthalmology, Neurology, Cardiovascular, Biosensors etc.

Biomaterials



Biomaterials

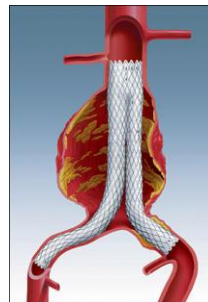
Biomaterial	Application
Silicone rubber	Catheters, tubing
Dacron	Vascular grafts
Cellulose	Dialysis membranes
Poly(methyl methacrylate)	Intraocular lenses, bone cement
Polyurethanes	Catheters, pacemaker leads
Hydrogels	Ophthalmological devices, Drug Delivery
Polyethylene	Orthopedic devices
Stainless steel	Orthopedic devices, stents
Titanium	Orthopedic and dental devices
Alumina	Orthopedic and dental devices

Biomaterials



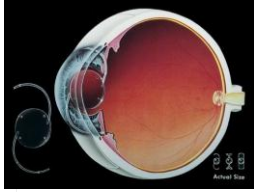
Application
Catheters, tubing
Vascular grafts
Dialysis membranes
Intraocular lenses, bone cement
Catheters, pacemaker leads
Ophthalmological devices, Drug Delivery
Orthopedic devices
Orthopedic devices, stents
Orthopedic and dental devices
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Biomaterials



Application
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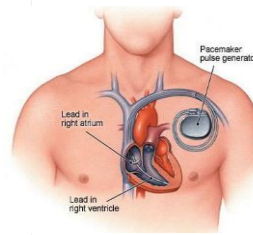
Biomaterials



Application

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Biomaterials



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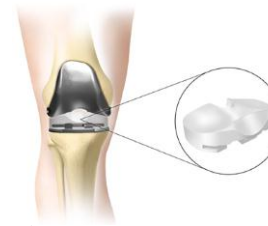
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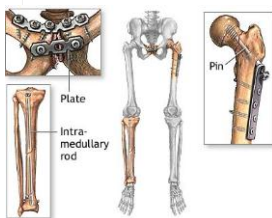
Biomaterials



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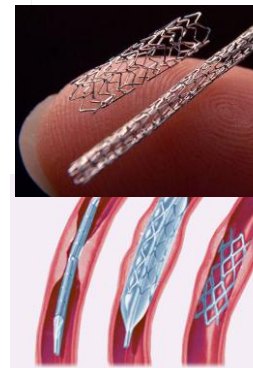
Biomaterials



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Problems/Tests for Biomaterials

- **Biomaterials are to be tested for:** Sensitization, Genotoxicity, Carcinogenicity, Neurotoxicity, Immunotoxicity, Pyrogen, endotoxins

ASTM F981 - 04(2010)

Assessment of Compatibility of Biomaterials for Surgical Implants w.r.t. Effect of Materials on Muscle and Bone

ASTM Standards	Tested for
F67	Specification for Unalloyed Titanium, for Surgical Implant Applications
F75	Specification for Cobalt-28 Chromium-6 Molybdenum Alloy Castings and Casting Alloy
F86	Practice for Surface Preparation and Marking of Metallic Surgical Implants

Generations of Biomaterials

Generation I

- "ad hoc" implants, common and borrowed materials

Examples: Teeth filling, Metallic bone plates, Glass eyes

Generation II

- Engineered implants built on first generation experiences
- Developed through collaborations of physicians and engineers

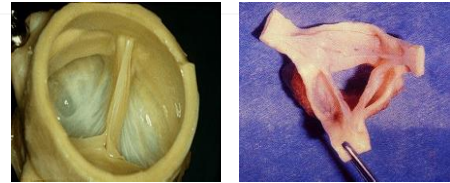
Examples: Ti alloy dental and orthopedic implants, Co-Cr-Mo implants, polyethylene bearing surfaces joint replacements

Generation III

- Bioengineered implants using bioengineered materials
- Some modified and new polymeric devices

Examples: Artificial skin, Resorbable bone repair cements, Tissue engineered implants designed to re-grow rather than replace

Generations of Biomaterials



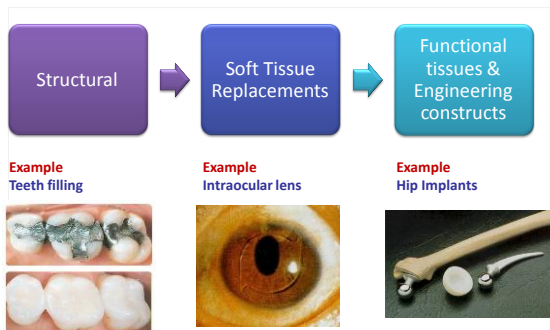
Substitute Heart Valves

Generation III

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Evolution of Biomaterials



Advancements & Challenges

Advancements

- Cell matrices for 3-D growth and tissue reconstruction
- Biosensors and Controlled/Targeted Drug Delivery
- Biohybrid organs and Cell immuno-isolation
- Bioactive, biodegradable, inorganic materials

Challenges

- To more closely replicate complex tissue architecture and arrangement *in vitro*
- To better understand extracellular and intracellular modulators of cell function
- To find better strategies for immune acceptance

Summary

- **Biomaterial Basics**
- **Types of Biomaterials – Metals, Polymers, Ceramics & Semiconductors**
- **Applications of Biomaterials - Orthopedics, Dentistry, Ophthalmology, Neurology, Cardiovascular, Biosensors etc.**
- **I, II and III Generation Biomaterials**
- **Evolution of Biomaterials**
- **Advancements and Challenges**