

Overview

What is a biomaterial?

The concept 'Biomaterial' is fairly frequently encountered these days. Associated with advanced medical solutions and replacement of body parts, it has a slight futuristic nuance to it. But what is a biomaterial? And where and why is this material used?

A biomaterial is a material designed to interact with the body

Contrary to what the word may implicate, a biomaterial is not necessarily biological or based on bio-related matter. The material itself can be anything from a metal to a plastic to varieties of composites, but it can also be bio-inspired and derived from nature. The definition of a biomaterial is a material that is designed with the purpose to interact with the body, i.e. it is designed to reside in a biological environment.

Biomaterial usage

Typically, the purpose of a biomaterial is to replace a missing piece of a body part, by replicating the structure that is no longer there, or to enhance function. Think of implants, such as hip joints, and heart valves, skin transplants, vascular grafts, and stents. Biomaterials are also used in less intrusive contexts, such as in contact lenses and wound care

From foreign material being tolerated by the body to purposeful material design

Although the biomaterial concept has a futuristic nuance to it, the desire and urge to mend a broken body is ancient. Attempts to replace or fix damaged or diseased body parts has existed for thousands of years. There are recordings of dental implants



already from the Mayan era, where the tooth implants were made of nacre from seashells. Throughout history, there are plenty of recordings of foreign material being more or less successfully introduced into the body. We have carbon particle-based tattoos, sutures made of catgut and heads of biting ants, glass eyes, and stainless-steel hips to name but a few. The scientific area of biomaterials science as we know it today, however, is relatively new. It started around the 60s. At this time, we went from using the materials we had at our disposal to engineer materials with the intent of increasing the material integration success rate, and the area of biomaterial science was born.

Biocompatible and functional materials

In the old days, of course, the concept and understanding of biocompatibility did not exist. Most likely, it was mere luck if the implanted material was tolerated by the body, and the patient did not suffer from any severe side-effects. Today we have a

good understanding of biocompatibility and tailor materials for desired interaction with the body. So, the material usage evolution has taken us from seashells in the Mayan period, to off-the-shelf materials such as polymers, metals, and ceramics after World War II, to engineered materials designed for biocompatibility in modern times. Here we find silicones, hydrogels, and hydroxyapatite, which today are commonly used. Now it is time for the next era. This aims to engineer materials which are not only tolerated by the body, but which also have functional properties, i.e. properties that can be tuned for example to control the physiological environment and induce a response, such as tissue repair.

Reference

Biomaterials Science, An introduction to materials in medicine, 3rd ed. Edited by Buddy D. Ratner, Allan. S Hoffman, Frederick J. Shoen, Jack E. Lemons