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Designer Collagen Fibers for Tissue Engineering Applications

Synthetic collagen peptides are engineered with metal binding sites to spontaneously self-assemble into diverse, highly controllable, and reversible 3D structures for use in biotechnology and materials applications.

Collagen holds organs in place, binds cells together, confers appropriate mechanical properties for tissues, and provides a framework for the body. The ubiquitous influence of collagen makes it an attractive target for implantable and regenerative tissue systems; however, the use of natural collagen in tissue engineering applications is limited due to difficulty with precise control of scaffold structures. Furthermore, natural collagen aggregates are inherently inconsistent, complicating precise introduction of biomolecules such as growth factors and cell adhesion agents. Synthetic collagen alleviates these problems, but there is still a need to control the 3D architecture of collagen networks.

Purdue University researchers have incorporated metal binding sites into small collagen peptides and used metal-ligand interactions to drive aggregation. Self-assembly of 3D structures is spontaneous, highly reproducible, and reversible. Fine, nanoscale detail and ultimate control at the single molecular level give rise to tunable shapes, sizes, and tertiary structures. Physical properties, such as mechanical strength, tensile strength, and porosity, may be modified in a predetermined way, as the physical properties of collagen play a central role in cell growth and differentiation. Reversibility of collagen aggregates, whereby aggregates are converted back to smaller subunits, may be advantageous for controlled release of drugs, cells, growth factors, etc. With aggregate structures so diverse, including spheres, nanospheres, hollow spheres, meshes, cages, microflorettes, fibers, and sheets, these designer synthetic collagen aggregates find applications across the spectrum.

Advantages:

-Control of 3D structure of collagen networks

Technology ID

65081

Category

Biotechnology & Life Sciences/Synthetic Biology & Genetic Engineering
Materials Science & Nanotechnology/Biomedical & Bioinspired Materials
Pharmaceuticals/Computational Drug Delivery & Nanomedicine

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-Excellent biocompatibility and bioactivity

Potential Applications:

-Biotechnology

-Materials

TRL: 3

Intellectual Property:

Provisional-Patent, 2008-05-15, United States | Utility Patent, 2009-05-15, United States | PCT-Patent, 2009-05-15, WO | NATL-Patent, 2009-05-15, European Patent | NATL-Patent, 2009-05-15, Australia | NATL-Patent, 2009-05-15, Canada | EP-Patent, 2016-10-18, Germany | EP-Patent, 2016-10-18, Netherlands | EP-Patent, 2016-10-18, Sweden | EP-Patent, 2016-10-19, Lithuania

Keywords: Synthetic collagen, 3D architecture, collagen networks, metal-ligand interactions, self-assembly, regenerative tissue, controlled release, nanospheres, biotechnology, materials