3D Printable Hydrogel Materials

This technology offers a series of hydrogel compositions that are responsive to temperature, applied pressure, and chemical crosslinking. The hydrogel does not degrade in water and is consistent in production and mechanical properties for specific applications.

What is the Problem?

Algal, bacterial, or yeast culture is common in the chemical and biotech industries for the large-scale production of food ingredients, metabolites, pharmaceuticals, biofuels, and chemical precursors for bioplastics. Product synthesis using a batch process involves combining living organisms, metabolites, nutrients, and water in a large reactor. The efficiency of the generation of a desired product requires strict control over physical parameters and chemical reactant concentrations in the reaction vessel, typically for several days. For example, fermentation is an exothermic process, but high temperatures can be detrimental to the microbes used in the reaction. Additionally, concentration levels of fermentation products such as ethanol can also be toxic to the cells. Because of the inefficiencies of batch processes, continuous processes, in which the reactants flow through a reactor system where the reaction takes place, and the desired product flows out of the reactor system, would be generally preferred in the commercial production of a desired product. A hydrogel structure containing an entrapped cell capable of catalyzing chemical reactions would be useful in a continuous culture process to produce chemical species. However, hydrogels are limited due to their complex preparation and their poor range of mechanical properties.

What is the Solution?

The solution is a series of hydrogel compositions that are responsive to temperature, applied pressure (shear thinning) and chemical crosslinking. Because of these properties, the hydrogel compositions can be uniformly embedded with a loading agent, extrusion (“3D”) printed, and crosslinked. The resulting crosslinked hydrogel structures do not chemically or physically degrade in water under ambient conditions and can therefore be used in various chemical processes involving the loading agent.

What Differentiates it from Solutions Available Today?

Existing batch processes lead to various inefficiencies. Existing hydrogel production is time intensive, inconsistent, and yields poor mechanical properties, limiting the adoption of the technology. This hydrogel-based technology would enable continuous processes instead of batch processes, eliminating many inefficiencies. This is enabled by the hydrogel structures that

Technology ID

BDP 8691

Category

Materials/Other

Selection of Available Technologies

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do not degrade in water. The fabrication methods can allow for consistent and rapid production coupled with a very broad range of mechanical properties, allowing for the mechanical properties to be tuned for each specific application.

Patent Information:

US10738297B2