Novel Biocompatible Hybrid Molecular Brush with Improved Adhesion to Fibroblasts for Wound Healing / Drug Delivery

Lead Inventor

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Unmet Need

This invention may address two areas of unmet need:

- ***Wound Care:*** Growing need for innovative wound treatment and care is driven by the increasing prevalence of surgical wounds and ulcers (diabetic foot ulcers, pressure ulcers, and venous leg ulcers), the increasing aging population, as well as increasing awareness about wound care treatment. Further, industry researchers cite an increasing demand for evidence-based advanced wound care products. The wound care market was $18.22 billion in 2016 and is projected to reach $26.24 billion at the end of 2023.
- ***Drug Delivery:*** Transdermal drug delivery offers a number of advantages over other drug delivery system such as improved efficacy-to-tolerability ratio by regulating serum drug levels, controlled and extended release of drugs, and avoidance of gastrointestinal and hepatic pre-systemic metabolism. As transdermal drug administration is an easy, painless, and convenient mode of application, patient compliance is generally high, especially in elderly and young people and patient groups who have difficulties swallowing or who are suffering from nausea or emesis. Transdermal drug delivery devices reduce not only dosing frequency, but possibly also side effects of the medication, and daily doses that have to be administered by other routes.

The Global transdermal drug delivery market reached $4,200.3 Million USD in 2016 and is expected thrive at a CAGR of 7.5% through 2024.

Opportunity

Hybrid molecular brushes (HMBs) are polymeric constructs comprising a backbone and ide chains of two or more polymers with varying properties. The overall molecular structure of HMBs is governed by steric repulsion among the side chains, and their grafting density on the backbone. HMBs with hydrophilic and hydrophobic fragments have recently come to the forefront, as their amphiphilic nature gives surfactant-like properties and facilitates formation of core-shell like micelles. The inventors currently are investigating potential applications as micro- and nanocarriers for site-specific drug delivery, stabilizers for emulsions, coatings for nanoparticles to prevent aggregation, and stimuli-responsive materials for protein binding.

Several methods for the synthesis of HMBs have been employed. Synthetic processes may be carried out in single step grafting process at elevated temperature, or in multiple steps involving modification of the backbone and/or side chains, followed by grafting. For the synthesis of HMBs with side-chains of varying chemical structure, immiscibility, and thus solvent selection poses a major challenge.

Therefore, there remains a need in the art for novel HMBs comprising varied polymer side chains, as well as methods of making them. In certain embodiments, the HMBs comprise a backbone, at least one hydrophobic polymer side chain, and at least one hydrophilic polymer side chain. This invention fulfills these needs.

Unique Attributes

- This invention provides methods of using the HMBs of the invention for ***tissue engineering applications***. In certain cases, the HMB is contacted to a wound on a subject, such as 1st or 2nd degree burns, to promote wound healing.
- In other instances, the HMBs are cast into a construct selected from the group consisting of films, patches, grafts, etc. The HMB construct also can comprise at least one antibiotic or at least one growth factor. The use of HMB to entrap a wide range of antibiotics and growth factors can help prevent infection and promote wound healing.
- The invention also provides methods of using these HMBs for drug delivery applications. It can be spray-dried as micro-particulates entrapping drug for depot therapy. In other instances, the HMB and drug are dissolved in an appropriate solvent, and the mixture is then spray-dried to enable encapsulation and microsphere formation. In yet other cases, the drug is a hydrophobic drug or a hydrophilic drug. ***The wide versatility of the HMBs to entrap both hydrophilic and hydrophobic drugs can lower formulation development costs, scale-up, and commercialization.***

Clinical Applications

Wound care, tissue engineering, and certain drug delivery applications.

Stage of Development

Preclinical early stage: in-vivo experiments.

Intellectual Property

US Patent No. 11,161,940

Collaboration or Licensing Opportunity

Actively seeking licensee for commercialization or collaboration to complete preclinical studies.

References and Publications

Synthesis and cell attachment study of hybrid molecular brushes with chitosan backbone as potential materials for wound healing; Chawathe, Manasi; Jonnalagadda, Sriramakamal; Sidorenko, Alexander; 255th ACS National Meeting & Exposition, New Orleans, LA, United States, March 18-22, 2018.

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