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Novel living ring-opening polymerisation method to synthesise a novel class of multifunctional, sequence-controlled, biodegradable and biocompatible polyesters and polyethers

Problems addressed

- Commonly used synthetic polymers are mainly statistical or random copolymers, in which the monomer sequence distribution is generally statistical and poorly controlled, leading to indisciplinable and unpredictable structural, physicochemical and biological properties.
- Living radical polymerisation methods are commonly used to synthesise polymers, which can potentially be used in pharmaceuticals and healthcare. However, existing living radical polymerisation methods synthesise polymers with carbon-carbon backbones that are non-biodegradable, which makes them inappropriate for many healthcare applications.

Technology overview

This invention relates to a novel quantitative, one-pot iterative living ring-opening polymerisation (QOIL-ROP) method for scalable synthesis of a library of novel polyesters and polyethers, that are not only sequence-controlled but also multi-functional with integrated biodegradability and biocompatibility. The QOIL-ROP method has been shown to precisely control the chain composition, monomer sequence and degree of polymerisation, to determine polymer physiochemical and biological properties and biodegradation behaviour. By precisely controlling the chain length and distribution of functional groups, multifunctional polyesters and polyethers can be generated for different purposes.

In addition, the scalable QOIL-ROP method does not require any intermediate purification procedures between successive chain extension steps, unlike the other reported iterative polymer synthesis methods. In each chain extension step, real-time monitoring of polymerisation can be carried out by nuclear magnetic resonance (NMR) spectroscopy and size exclusion chromatography (SEC) to achieve quantitative monomer conversion.

Proposed Use

The biodegradable and biocompatible copolymers with controlled structural versatility and functional diversity have various healthcare applications especially in targeted delivery of drugs, peptides, proteins and nucleic acids, vaccine formulations, and tissue engineering.

Benefits

- Simple, scalable and cost-effective polymerisation method
- Catalysts used are non-toxic, commercially available and U.S. FDA-approved
- Generates a library of novel water-soluble, multifunctional, sequence-controlled polyesters and polyethers with biocompatible and biodegradable backbones that existing polymerisation methods could not achieve
- Manufactured polyesters and polyethers have precisely controllable monomer types, sequences and chain lengths that allow for tuneable functionalities and site-selective post-polymerisation modification as needed
- Generated polyesters and polyethers have various healthcare applications including targeted compound delivery, vaccine formulations, gene therapy and tissue engineering

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