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Poly(propylene carbonate)(PPC)-Based Amphiphilic Block Copolymers, and Methods of Use Thereof

A new delivery system uses biocompatible polymer micelles and a catalyst to locally generate CO2 bubbles in target tissue under mild heating for enhanced ultrasound and biomedical imaging applications.

Poly (propylene carbonate) (PPC) is a plastic material that can be mass produced from naturally abundant carbon dioxide. This polymer is also known to decompose back to CO2 when heated to a specific temperature. It is a promising material for pharmaceutical and biomedical applications due to this biodegradable and biocompatible nature, and the released gas can be used for imaging, such as ultrasound, when the material is bound to a site within a patient's body. However, the decomposition temperature is above 200 degrees C and bulk PPC is not water soluble. Therefore, use of PPC for such processes has been limited. Conventional gas-containing ultrasound contrast agents consist of a nano- or micron-sized gas bubbles surrounded by a shell layer made of a polymer or lipid. These previous systems have suffered from several problems and shortcomings, including limited stability, low efficiency of delivery, and difficulty of manufacture.

Researchers at Purdue University have investigated the thermal degradation of a PPC-based amphiphilic block copolymer, and found that these triblock copolymers form stable small-sized (less than 200 nm) micelles in water. They have also demonstrated that the CO2-generation temperature of PPC can be reduced down to the 40-80 degree C range in aqueous environment by using a catalyst for activating the random scission reaction of PPC. Therefore, with using micelles and the catalyst, the CO2 bubbles can be generated within a target tissue in vivo by delivering the polymer as micelles, and the gas is produced by hydrolysis of the polymer precursor in mild heating conditions.

Advantages:

-Bubbles generated in target tissue

Technology ID

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Category

Chemicals & Advanced Materials/Polymer Science & Smart Materials

Materials Science & Nanotechnology/Biomedical & Bioinspired Materials

Pharmaceuticals/Computational Drug Delivery & Nanomedicine

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-Enhanced imaging

Potential Applications:

-Ultrasound devices industry

-Biomedical technology

TRL: 3

Intellectual Property:

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