Knowledge Transfer Office
香港城市大學
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Core-shell Nanoparticles, Methods of Producing the Same, and Uses Thereof for Detecting Extracellular Polymeric Substances

Health & Wellness

Biomedical and Genetic Engineering

Opportunity

Extracellular Polymeric Substances (EPS) play a crucial role in the biofilm structures and functional properties of various microorganisms. Due to its significant biocompatibility, non-toxicity, and other functional benefits, EPS holds potential for various biotechnological and therapeutic applications. Accurately quantifying and monitoring EPS production is essential to harness these benefits effectively. To date, numerous analytical methods, such as CLSM, have been used for characterizing EPS. However, a significant gap remains in the field: there's an absence of a fluorescence labeling method capable of visualizing the highly diverse EPS matrix in general. Conventional luminophores suffer from issues like low resistance to photobleaching, limited Stokes shift, and resulting low resolution. Thus, a unique opportunity exists to develop a novel fluorescent probe that can precisely detect and provide long-term imaging of EPS across different microorganisms.

Extracellular Polymeric Substances (EPS) are vital components in microbial biofilms with promising applications in biotechnology and medicine. Current methods to quantify and monitor EPS, like Confocal Laser Scanning Microscopy (CLSM), have their limitations. Most notably, existing fluorescent labeling techniques struggle to visualize the diverse EPS matrix across different microorganisms. Conventional probes also face challenges such as rapid photobleaching, and low resolution due to a minimal Stokes shift. Given the rising importance of EPS in various applications and the challenges in its precise detection, there is a clear market demand for a more advanced, reliable fluorescent probe to bridge this technological gap.

IP Status
Patent filed

Technology Readiness Level (TRL) ?
5

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Technology

Comprising a core with embedded tetraphenylethane (TPE) within a hydrophobic polymer matrix and a hydrophilic polymer shell, these nanoparticles exhibit aggregation induced emission (AIE) properties. This AIE phenomenon contrasts traditional organic luminophores, which can undergo rapid photobleaching. The nanoparticles' structure ensures their stability and fluorescence properties, making them ideal candidates for EPS detection. When these nanoparticles come into contact with microorganisms, they can be irradiated with light at a specific wavelength, and the emitted fluorescence can be measured to detect the presence and quantity of EPS. Given the intrinsic properties of these nanoparticles, they offer enhanced resistance to photobleaching, thereby ensuring long-term monitoring capabilities. Additionally, their unique core-shell composition potentially minimizes self-absorption and augments resolution, allowing for real-time monitoring of dynamic EPS changes across a variety of microorganisms.

Core-shell nanoparticle, a nanoparticle, with tetraphenylethane (TPE) embedded in a hydrophobic core and a hydrophilic outer shell, introduces aggregation induced emission (AIE) capabilities. Unlike traditional luminophores prone to quick photobleaching, these nanoparticles are robust. Their unique composition ensures stable fluorescence, optimal for EPS detection. When these particles interact with microorganisms and are exposed to specific light wavelengths, they emit a detectable fluorescence linked to EPS presence. Crucially, they resist photobleaching and provide enhanced resolution, making real-time and long-term monitoring of dynamic EPS changes feasible and efficient. This solution promises better EPS visualization and analysis.

Advantages

- Improved fluorescence labeling for visualizing and quantifying EPS in biofilms
- High resistance to photobleaching under strong laser irradiation
- Strong fluorescence emission when aggregated, providing enhanced visibility
- Long-term monitoring of EPS due to improved photostability
- Higher resolution for real-time imaging of dynamic changes in EPS

Applications

- Environmental monitoring of biofilms and microbial communities
- Biotechnology and biomedical applications involving EPS
- Therapeutic applications that involve EPS analysis and monitoring
- Research and development of biofilm-based technologies and materials