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Producing recombinant poly-γ-glutamic acid as 'mortar' of biomimetic nacre

Nadine Bongaerts
Delft University of Technology, The Netherlands

Pearls and the inner lining of mollusc shells consist of nacre, a material with extreme fracture toughness and hardness. Its complex microstructure resembles a brick wall in which the bricks consist of calcium carbonate platelets that are held together by an organic matrix of chitin, silk fibroin and hydrophilic proteins acting as the mortar. Developing a material with superior nacre-like properties in an efficient and environmentally-friendly manner would represent a milestone in the development of composite materials with improved properties. This research takes a biological approach towards this goal and uses the abilities of recombinant *E. coli* cells to produce a nacre-like material in a controllable manner. We equip bacterial cells with the ability to excrete the anionic biopolymerpoly-γ-glutamate (γPGA) to serve as a scaffold (mortar) on which our engineered cells catalyse the formation of a calcium carbonate layer (bricks). γPGA has negatively charged side groups that can provide nucleation sites for $CaCO_3$ precipitation and is naturally synthesised by various bacterial species. γPGA related biosynthesis genes pgsBCA and race of *Bacillus licheniformis* under the control of inducible promoters were introduced into *E. coli* and successfully expressed heterologous γPGA. Optimization of the culture conditions resulted in cells expressing well over 1 g/LγPGA after 48 hours of growth. Furthermore, an assay to measure γPGA concentrations was developed to determine the product productivity in time. Finally, we are aiming to control the polymer size using γPGA depolymerase activity (*B. licheniformis* PgdS) for potential optimization of $CaCO_3$ precipitation on top of the YPGA matrix.

Biography

Nadine Bongaerts is pursuing her Master's at the Delft University of Technology. She completed her Bachelor's in Life Sciences & Technology (Leiden University & TU Delft). She successfully participated in the worldwide iGEM competition for Synthetic Biology in 2010. Her team ended as one of the finalists with 'A genetic toolkit for *E. coli* to enable hydrocarbon conversion in aqueous environments'. Next to her scientific endeavours, she has co-founded science communication company Biotecture and holds a position as Global Community Director for the international non-profit organisation Hello Tomorrow.

nadine.bongaerts@gmail.com

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