Molecular recognition of autoinducers by Molecularly Imprinted Polymers as anti-biofilm strategy

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Molecularly Imprinted Polymers (MIP) are capable of selectively recognizing a targeted molecule, a property arising from their synthesis method **(Fig.1)**. MIP are crosslinked rigid networks designed to have specific cavities that are tailored to match the shape and chemical properties of a target molecule, which is used as a template during its preparation. The polymerization process involves one or more functional monomers that are carefully selected for their specific affinity with the target molecule. The use of a high amount of crosslinker locks the steric arrangement of functional monomers around this template. Upon removal of the template, complementary binding sites are created, enabling selective recognition of the target molecule through interactions such as hydrogen bonding [1].

Biofilm formation occurs and causes problems in various environments, leading to major economic and environmental impacts (navigation or water treatment sectors) as well as public health concerns (medical, food industry). Within a biofilm, bacteria can communicate and cooperate through a system known as *quorum sensing* (QS) using small signaling molecules called autoinducers (AI), which provide them with a collective adaptability to their environment [2]. The QS regulates processes like biofilm development. Inhibiting this chemical communication between bacteria by sequestring AI using MIP would contribute to the search for new biofilm control strategies [3].

The target molecules of the strategy here are the AI from the acylated homoserine lactone (AHL) family. Instead of using one AHL in particular as template molecule, an analog dummy template **(Fig.2)** was used with the aim of recognizing the entire AHL family with only one tailor-made MIP. The study of commercial and original functional monomers by proton and carbon NMR, highlighted the strength of H-bonding and led to the selection of acrylamide as a suitable monomer to specifically interact with AHL. Using EGDMA as the crosslinker, several MIPs and their non-imprinted polymer (NIP) counterparts were synthesized by precipitation polymerization under different conditions of time, temperature, and concentration. The characterization of these polymers, including their morphology (SEM), their porosity and specific area (BHJ, BET), along with the determination of their adsorption isotherm (LC-MS), demonstrated their ability to recognize and capture targeted AHL. Testing these polymers in complex microbiological environments (initially using *Vibrio harveyi* as AHL-producing baterium) has confirmed their ability to sequester AHL, their anti-biofilm properties, and their non-cytotoxicity, showcasing their potential for biofilm control.

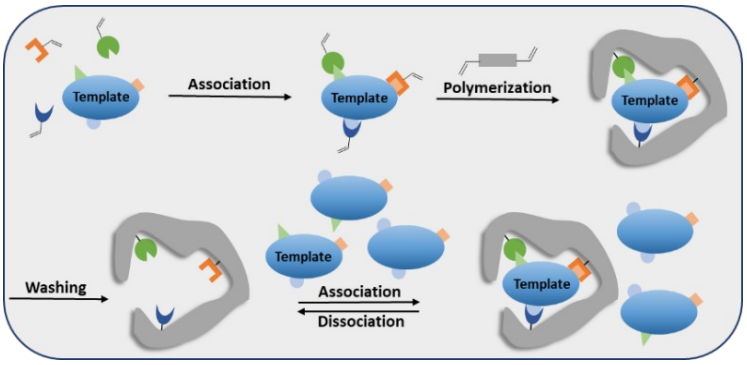

Figure 1 : Synthesis of Molecularly Imprinted Polymer

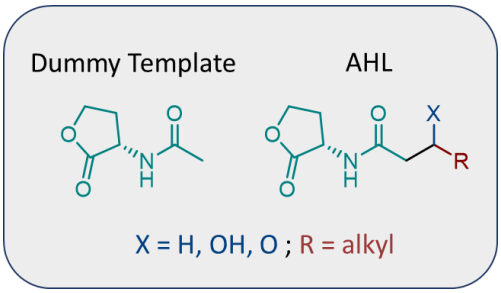

Figure 2 : Dummy Template and AHL family

References

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[3] Yangcui, Q.; Yi, Z; Guannan, W.; Yanxia, Z.; Qian Y., Disrupting of Communication: Recent Advances in Antibiofilm Materials with Anti-Quorum Sensing Properties. *Appl. Mater. Interfaces*, **2024**, 16, 13353-13383