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SERS-based microfluidic platform for antibiotic detection in seawater

Antibiotic detection in marine environments is a growing concern, as their presence can cause ecological imbalances and foster antibiotic resistance [1]. In our study, we explore the use of surface-enhanced Raman scattering (SERS) as a promising analytical tool for detecting these contaminants owing to its high selectivity and its status as one of the most sensitive techniques currently available. Additionally, SERS offers other advantages that hold particular significance in sensor development, including reduced time requirements and the potential for in-situ measurements, which are important for real-time water monitoring [2].

The applicability of SERS depends on the fabrication of efficient substrates. Here, hybrid SERS substrates were developed by functionalizing gold nanostars (GNS) with β -cyclodextrin, which is a large molecule made of repeating glucose units with a hydrophobic cavity that can bind different antibiotics [3]. The functionalization of GNS with β -cyclodextrin facilitates the concentration of antibiotic molecules near the plasmonic surface, generating an unique SERS fingerprint spectrum that enables the detection of different antibiotics.

We integrated a highly sensitive SERS substrate into a microfluidic platform to enable automated, reproducible, and ultra-fast multiplexed detection [4]. After evaluating the substrate's mixing and stability in artificial seawater, we successfully detected different antibiotics using an in-house-developed closed microfluidic chip paired with a portable 785 nm Raman system. The initial results on the fluoroquinolones detection indicate that this approach shows great potential for developing an autonomous, in-situ sensor with high sensitivity for monitoring antibiotics in water systems.

References

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