Portable SERS-based detection system for ultra-detection of H_2S

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Hydrogen sulphide (H_2S), a product obtained by sulphate reducing bacteria, presents a high risk for aquaculture sector. This molecule with high toxicity, even at low concentrations, is responsible to increase the susceptibility of marine organisms to disease. To avoid this, different sensors, with the limit of detection in µM range, are used by the industry to detect this molecule. However, 1.6 µM is stablished as the highest concentration that should be detected in aquaculture systems. Thus, it is imperative the development of sensors to detect H_2S in water at lower concentration (nM range).
In this work, we are developing a portable surface-enhancement Raman scattering (SERS)-based sensor in order to decrease the limit of detection of H_2S. Over the last decades, anisotropic noble metal nanostructures are being exponentially used because offer large enhancement factors and good reproducibility, allowing single-molecule detection by SERS. Specially, gold nanostars (GNSs) that allow to reach an enhancement factor up to 10^{12}, by concentrating their electromagnetic field in the limit of their sharp branches using the core as an electron reservoir [1], [2]. Taking this advantages into consideration, we are immobilizing SERS substrate (GNSs) on poly (methyl methacrylate) (PMMA) (8 mm^3) and post-functionalized it with a molecular probe that responds to the presence of H_2S, such is the case of 6-mercapto-striazolo(4,3-b)-s-tetrazine (MTT) [3] and 4-Mercaptobenzoic acid (4-MBA), by displacement of these molecular probes and consequent decrease in SERS signal. This cubes are then integrated into a microfluidic device (consisting in an inlet, a reservoir that acts as sensing area and an outlet) (figure 1) improving the sample delivery to the GNSs and reduction of the acquisition times for H_2S detection using a portable Raman. Through this portable sensor, we have been able to achieve a detection limit in the nM range for Na_2S-spiked water samples.

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FIGURES

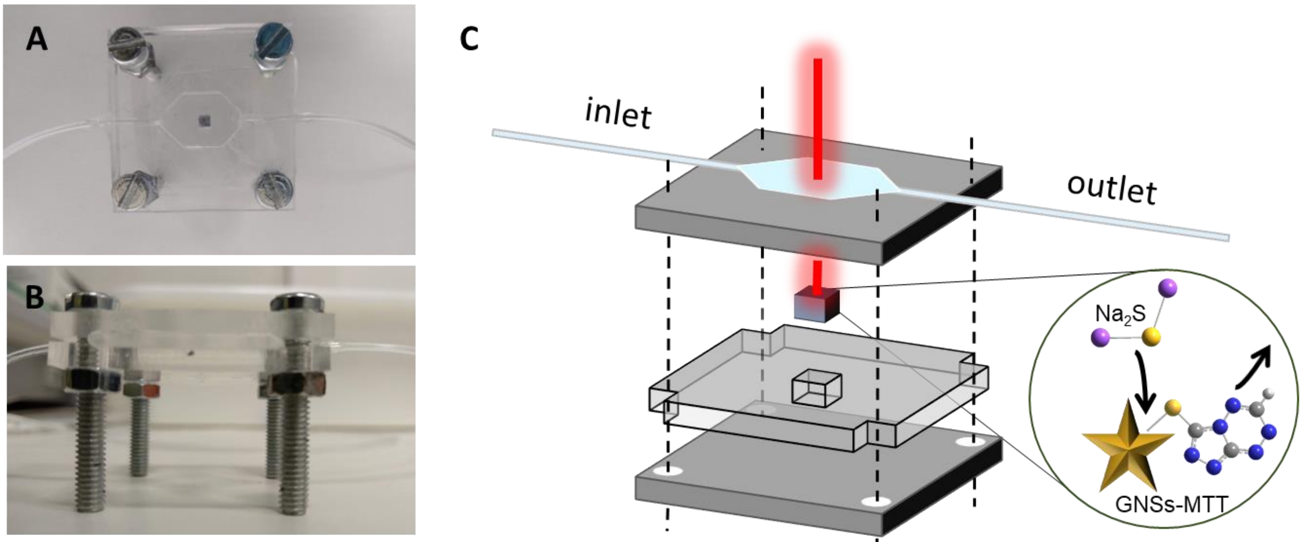

Figure 1: H_2S SERS-based sensor prototype. (A) from top (B) from side (C) schematic representation.