ION-EXCHANGED GLASS MICRORODS FOR SERS DETECTION OF DNA

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Different chemical or physical deposition processes have been previously proposed to equip surfaces with a layer of plasmonic NPs to produce effective SERS responses. Here, we present a SERS biosensor obtained by an ion-exchange process in soda-lime glass microrods for efficient DNA detection.
Keywords: SERS, ion-exchange process

1. Introduction

Surface-enhanced Raman spectroscopy (SERS) is a well-established technique able to detect a wide variety of chemical substances and/or biological molecules due to its capability of acquiring the unique vibrational information associated with them (i.e.: their spectral fingerprint) in different chemical and/or bio-chemical matrixes. Usually, the well-known enhancement effect for SERS is associated with the presence of metallic nanoparticles (NPs) at the substrate surface. Different chemical or physical deposition processes have been proposed to equip the substrate surface with a NPs layer. The former approaches are low cost but lack of reusability and stability. The latter strategies are expensive, time consuming and require special equipment that complicate the fabrication process.

2. Results and Discussion

Here, we demonstrate the possibility to obtain stable and reusable SERS platforms by low-cost silver-sodium ion-exchange process in soda-lime glass microrods. These microrods were obtained by cutting the tip of the ion-exchanged soda-lime fibre. Their final size were around few millimeters in length and one hundred microns in diameter. The ion-exchange and thermal annealing post-process parameters were optimized in order to guarantee the presence of embedded silver NPs on the surface of the glass microrods, avoiding the use of any chemical etching. The subsequent Atomic Force Microscopy (AFM) analysis confirmed the presence of these silver NPs with size of tens of nm.
As preliminary bioassay test on such SERS platforms, a DNA hibridization assay was performed. In particular, the DNA-sequence [5'(ATTO647N)-CGACGGAGAAAGGGCTGCCACGXCG(BBQ)-3' X=C6-dT Thio] (1 mM) was immobilized on the silver NP via the thiol group and subsequently made react with the target sequence [5'-CCCCTGCCTGGCAGCCCTTTCTCAAGGACC-3'] (1 mM).
SERS experiments confirm the presence of the DNA-sequence on the NPs embedded on the microrods surface, and its ability to interact with the target sequence was monitored by following the variations in the principal Raman spectral bands correlated to the oligonucleotides chain.
These results are preparatory for the development of a new class of SERS fiber probes, based on multi-component glass oxides and suitable to host metallic NPs by ion-exchange process.

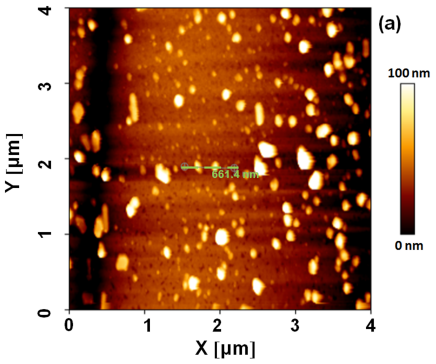

Fig.1 AFM image from a 4µm × 4µm area of the glass microrod. The presence of silver NPs on the surface is clearly visible.

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