Layer-by-Layer Assembly of Silver Nanoparticles on Diatom Strips for Surface-enhanced Raman Scattering

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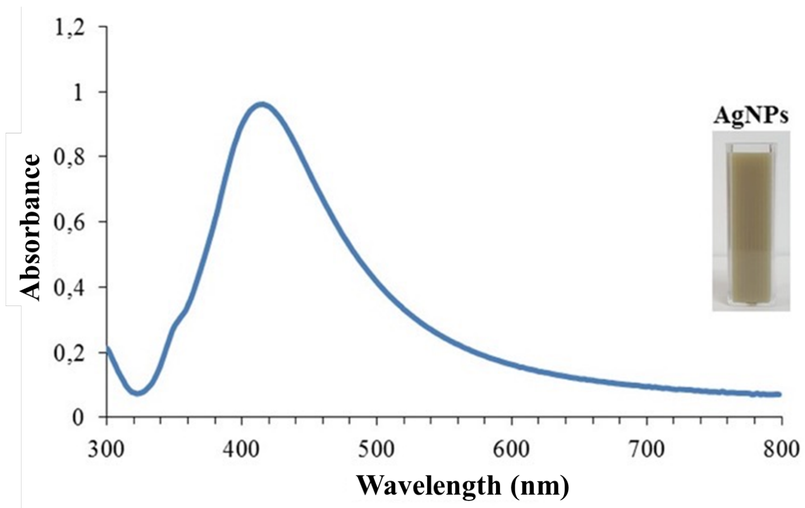
INTRODUCTION

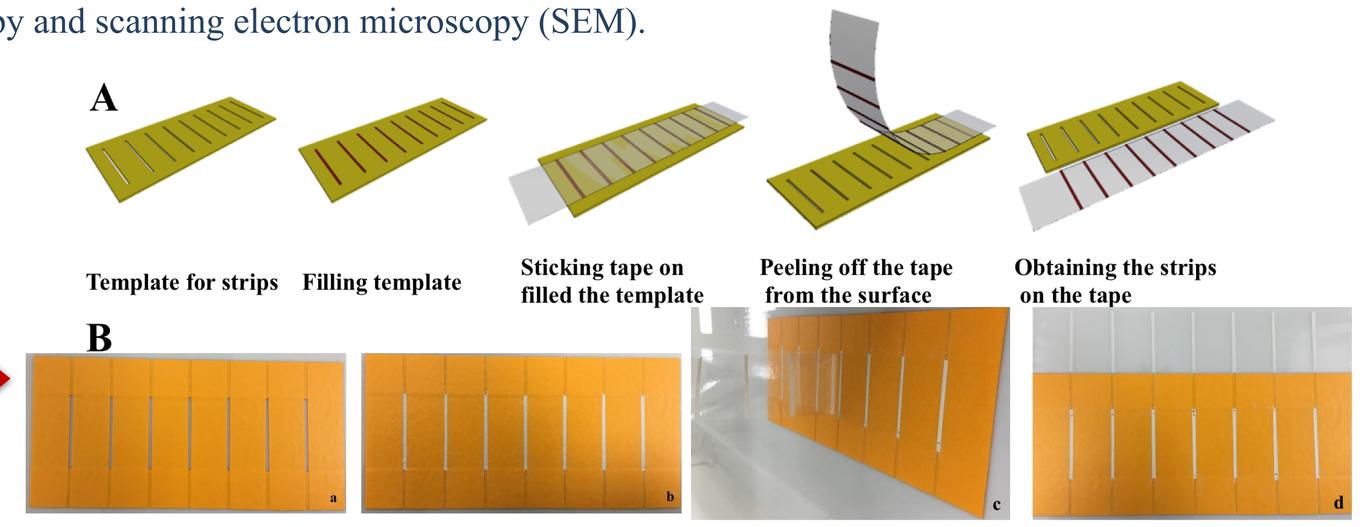
Surface-enhanced Raman Scattering (SERS) is an emerging analytical technique used for characterization of biological and non-biological structures [1,2]. Plasmonic properties of nanostructures are main factors influencing SERS performance. Thus, fabrication of plasmonic nanostructures having different plasmonic properties is significant research interest. Recently, guided-mode resonances (GMRs) in diatoms have significant attention due to their potential contribution to SERS enhancement [3-5]. Furthermore, there is also evidence showing that diatoms can be utilized in improving SERS enhancement by optically coupling the GMRs of the diatom frustules with the LSPRs of the nanostructures. In this study, inexpensive, robust, and flexible diatom-based SERS platforms on box tapes are fabricated. The SERS performance of the platforms was evaluated using 4-aminothiophenol (4-ATP) and rhodamine-6G.

MATERIALS METHODS

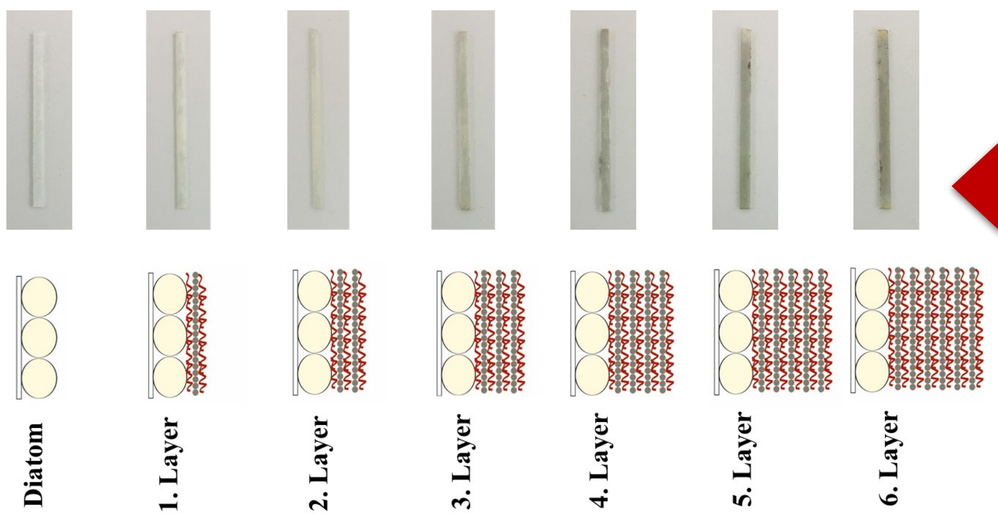
Diatom strips are fabricated using a template and assembled AgNPs using layer-by-layer method to obtain diatom/AgNP nanocomposite strips having six different layers. The fabricated SERS platforms are characterized using UV-Vis spectroscopy and scanning electron microscopy (SEM).



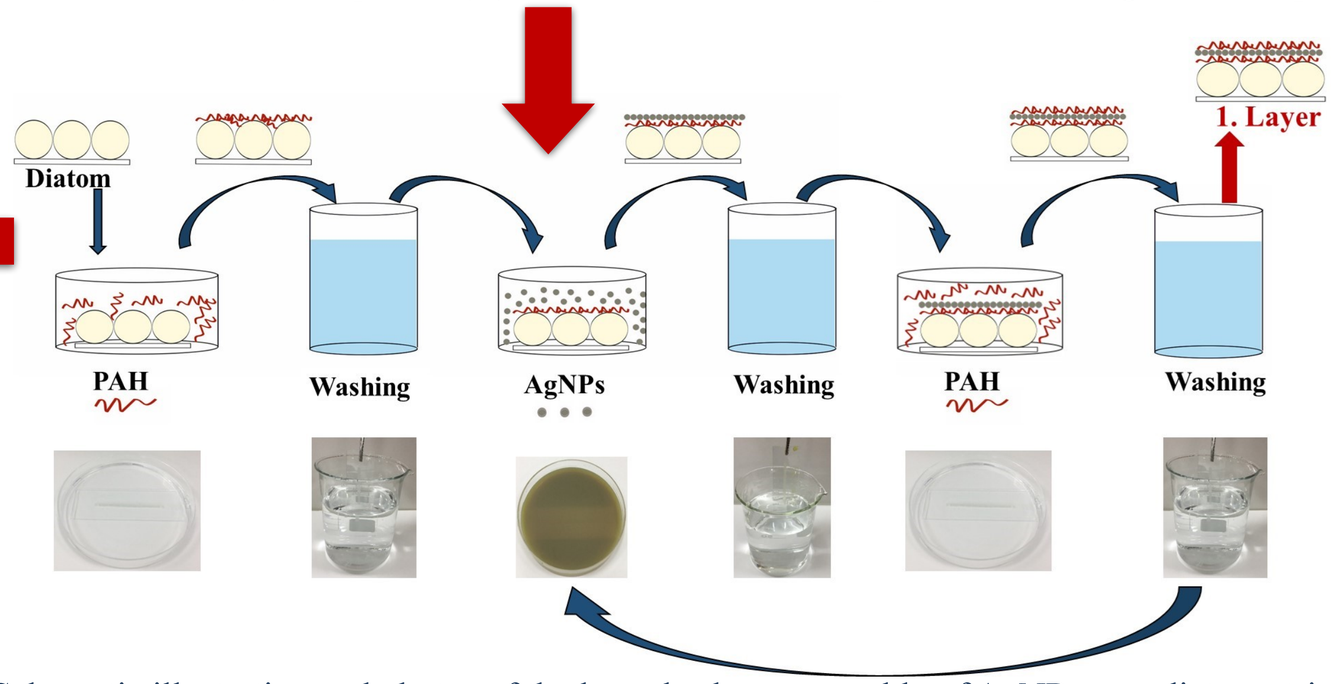
UV/Visible absorption spectrum and suspension color of the synthesized AgNPs.



Schematic illustration (A) and photos (B) of fabrication of diatom platforms on a regular box tape.



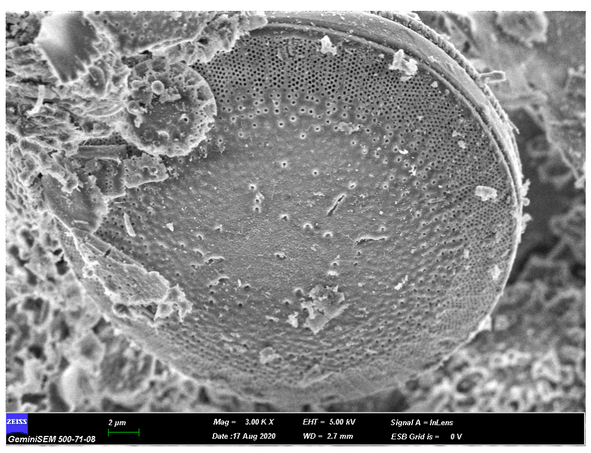
Strips color changes depending on the number of the AgNPs layers and schematic illustration of the layers.

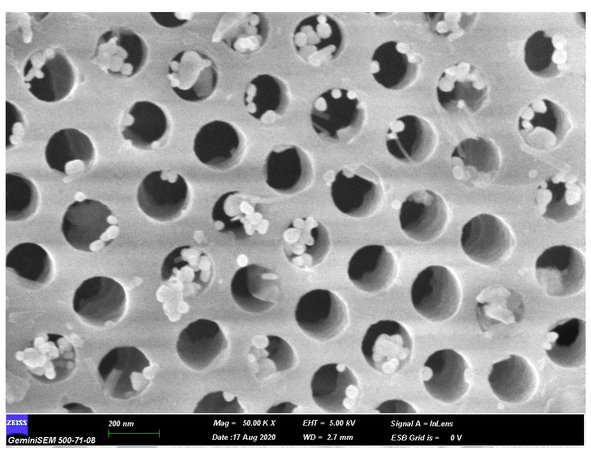


Schematic illustration and photos of the layer-by-layer assembly of AgNPs on a diatom strip.

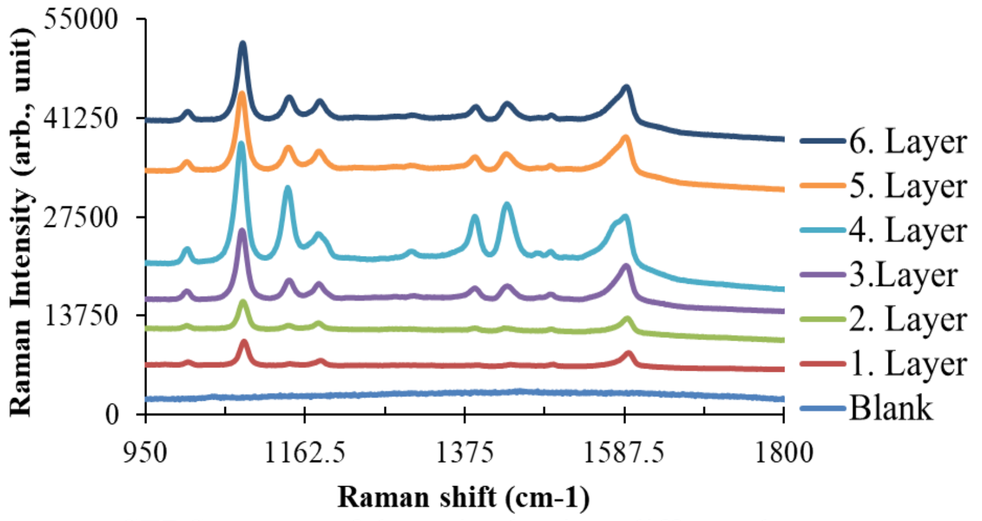
RESULTS AND DISCUSSION

In this study, SERS active diatom/AgNPs strips were fabricated using the layer-by-layer assembly of AgNPs strips on a diatom strips. The fabricated strips having different number of layers were characterized using SEM. Then, SERS performance of the strips were tested using 4-aminothiofenol (4-ATP) molecules. The maximum SERS performance were obtained on the strip having four number of the AgNPs layersThe results demonstrate that SERS performance of the platforms are dependent on the number of layers of the structures. The SERS platform having highest SERS activity can be used for the characterization of any molecules of interest.

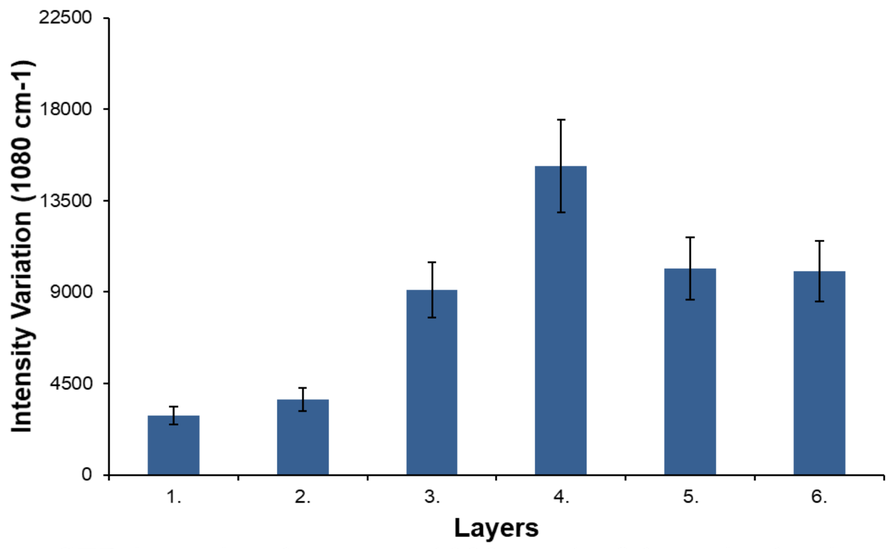




SEM images of diatom-AgNPs strip.



SERS spectra of the strips having different layers.



SER intensity changes at 1080 cm-1 of the strips having different layers.

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Acknowledgments

The financial support of TUBİTAK (project number 119Z091) and TÜBA-GEBİP are gratefully acknowledged.