Silver-decorated silicon nanostructures for plasmon-induced enhancement of Raman scattering and fluorescence

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Three-dimensional metal nanostructures can give rise to considerable plasmon-induced enhancement of Raman scattering and fluorescence, rendering these spectroscopies sensitivities down to single molecule detection. Specifically, excitation of surface plasmons at nanogaps between metallic nanoparticles can greatly enhance local electric fields so that Raman signals of substances at these gaps can be increased considerably in comparison to conventional Raman. This is known as Surface-Enhanced Raman Scattering (SERS). Also, if the absorption or the emission spectrum of a substance overlaps with the excitation spectrum of a metal plasmon in the vicinity of the substance then this coupling can induce considerable fluorescence enhancement. In this study, we present a method to fabricate a Si-based three-dimensional nanostructure decorated with silver nanoparticles and demonstrate its high potential to render significant Raman and fluorescence enhancements [1]. In this method, silicon nanowires (SiNWs) were developed by metal-assisted chemical etching (MACE) and decorated either with silver dendrites or silver aggregates. Silver aggregates show greater uniformity regarding SERS whereas dendritic silver nanostructures show better performance for fluorescence. For the evaluation of the samples prototype analytes such as rhodamine R6G and crystal violet were used. Finally, the performance of the samples in detecting substances of biological interest is going to be presented.

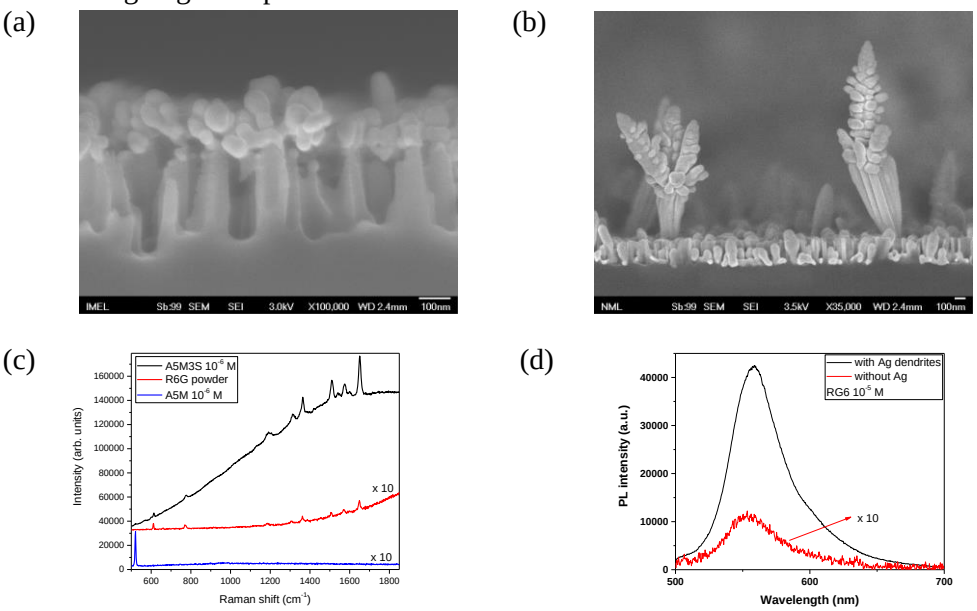

Figure 1: SEM images of the silver decorated SiNWs grown by MACE: a) silver aggregates, b) silver dendrites. Plasmon-induced: c) Raman and d) fluorescence enhancement.

References

[1] I. Kochylas, S. Gardelis, V. Likodimos , K.P. Giannakopoulos ,P. Falaras and A. G. Nassiopoulou, Nanomaterials **11**, 1760 (2021)

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