Optimizing Signal-to-Noise Ratio of SERS Ag Capped Si Nanopillars

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Publication date:
2014

Document Version
Publisher's PDF, also known as Version of record

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Citation (APA):
Optimizing Signal-to-Noise Ratio of SERS
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Introduction
A simple approach for mass-production of wafer-scale Ag capped Si SERS nanopillars is presented. Recorded SERS spectra exhibit uniform E-field enhancement properties while retaining low background signals over large surface areas (>cm²).

Reference:

Discussion
• FEM results in figure 2 show that the most prominent resonance mode is located in the near-infrared spectral region and contributes most to the SERS performance as well as the background of Ag NPs.
• Figure 3 and 4 show that O₂-plasma exposure and Cr separation layer both reduce the background signal. However process parameters should be carefully chosen to prevent decrease of the EF. Moreover, by varying thickness of the evaporated Ag film, EFs of the SERS substrate can be further increased, see the left part of figure 5.
• Figure 5 shows that a further optimized substrate by varying thickness of Ag evaporated is able to detect 100 pM BPE showing a spectrum which contains five clear Raman vibration modes. The substrate also exhibits high EF uniformity with standard deviations of ~14% across a 5 mm x 5 mm chip.

Conclusion
A simple approach for mass-production of wafer-scale Ag capped Si SERS nanopillars is presented with emphasis on signal-to-noise ratio. Experimental findings suggest that the Ag NP substrates are strong candidates for obtaining a reliable SERS sensing at ultra-low concentrations. The fabrication process is simple, cost-effective, CMOS compatible and could be suitable for mass-production in standard IC foundries utilizing even larger Si carrier wafers.

This work has been funded by the NAPLAS project, The Danish Council for Independent Research.
Reference: