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Tuning of Morphology and Plasmonic Properties of Gold Nanoislands through Thermal Budgeting

Kyana Mohammadi[1], Duraichelvan Raju[1], Mahdi Derayatifar[1], Simona Badilescu[1], Muthukumaran Packirisamy[1]
[1]Optical Bio-Microsystems Laboratory and Micro Nano Bio Integration Center, Department of Mechanical, Industrial and Aerospace Engineering, Concordia University, Montreal, Canada

Extended Abstract

The efficacy of plasmonic biosensors is significantly influenced by the morphology of gold nanoislands, which governs their Localized Surface Plasmon Resonance (LSPR) properties [1]. In this study, we explored the effect of thermal budgeting on the morphology and consequent plasmonic characteristics of gold nanoislands to increase the sensitivity of LSPR-based biosensing platforms. We were able to manipulate the thermal budget on single-layer gold nanoislands coated on glass substrates [2] by employing a meticulous methodology of alternating between deposition (D) and annealing (A) processes.

Our investigation entailed the variation of deposition and annealing sequences, adjusting the number of cycles to tune the morphology. The spectral analysis focused on the LSPR peak absorption shifts and the broadening indicated by bandwidth of lambda at 90% peak absorption. These parameters shed light on the morphological changes—size distribution and particle density—induced by different thermal treatments.

The results demonstrated a correlation between the thermal budget and the plasmonic responses. Redshift in the peak absorption wavelength was noted with an increase in annealing steps, signifying a morphological evolution towards larger or more clustered nanostructures. Concurrently, an expanded bandwidth was observed, indicating a broadening of the absorption peak and hinting at a greater size variation among the nanoislands.

Sensitivity in biosensors is linked to the LSPR peak's position and sharpness, with sharper peaks offering higher resolution for detecting minute refractive index changes [3-4]. Our research reveals that thermal budgeting can be harnessed to fine-tune the morphology of gold nanoislands, culminating in a tailored LSPR response. This tunability is essential for applications where the detection of specific biomolecular interactions is required.

In conclusion, our study underscores the significance of manipulating the thermal budget to refine the morphology of gold nanoislands, directly affecting their plasmonic properties. By delineating the relationship between the deposition and annealing sequences and the LSPR features, we pave the way for the development of highly sensitive and precise biosensing platforms.

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