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Outline of thesis

The following list describes the outline of this thesis:

CHAPTER 1: Introduction

In this chapter, first the background of nanotechnology and broad application of plasmonic nanostructure is briefly introduced. Then, nanostructure fabrication techniques including top-down and bottom-up methods are reviewed. The research objectives and approaches are also covered in this chapter.

CHAPTER 2: Development of 2D metallic nanodot/rod arrays

This chapter covers the first phase of this research project, a preliminary study of Nanoplastic forming (NPF), coating and thermal dewetting techniques was conducted. Experiments works were carried out to study the effect of annealing time, annealing temperature and pitch setting on morphology and localized surface plasmon resonance (LSPR) properties of the nanodot array. A theoretical model was proposed. Both the experimental and calculated data exhibit similar trend that the peak wavelength decreases with the increase in annealing time. After that, nanodots were extended to nanorods, experiments on various annealing conditions and sputter etching pre-treatment were conducted to obtain the optimum conditions for an ordered nanorod array.

CHAPTER 3 – Development of 3D metallic nanodot arrays

The second phase of this research project was described in this chapter. In order to obtain 3D nanodot array, 2D nanodot arrays were piled up to multilayer nanodot array by repeating spacer layer deposition, metal deposition and thermal dewetting. Experimental works were conducted using gold as the dot material and SiO_2 as the material of the spacer layers. The effective parameters influencing dot formation on the second layer, including Au layer thickness and SiO_2 layer thickness, were studied. The mechanism of the dot agglomeration process was studied based on geometrical models. The effects of the spacer layer thickness and the Au layer thickness on the morphology and alignment of the second layer dots were discussed. The optical properties of

double-layer and multilayer nanodot arrays were also investigated.

CHAPTER 4 – Development of "Dot-on-Plate" (DoP) arrays

In this chapter, first the fabrication procedures for "Dot-on-Plate" (DoP) nanostructure arrays are presented. The second phase of this research project was continued in this chapter. DoP nanostructures were fabricated based on the double-layer nanodot fabrication technique. Then, the optical properties of the nanostructure array were studied. In the final session, the structure was utilized for surface-enhanced Raman scattering (SERS) application and the influencing parameters were investigated.

CHAPTER 5 – Development of 3D nanopillar arrays

This is the third phase of this research project. 3D nanopillar arrays were fabricated by selective etching process using the 2D nanodot array as a mask. Au dots were remained on the pillars, and these Au-capped nanopillars were shown enhanced refractive index sensitivity compared with nanodot array on flat substrate. As for the SERS application, experimental work was conducted to investigate the enhancement of Raman intensity from the Au-capped nanopillars with Ag coating.

CHAPTER 6: Conclusions

This final chapter of this thesis describes the concluding summary of the research project.