CHAPTER I

INTRODUCTION

1.1 Anisotropic structures for functional materials.

Recently, metal nanostructures are of interest for researchers due to their differentially unique properties with bulk materials and promising applications in catalyst e.g., oxidative coupling, electrocatalytic [1, 2], biosensor e.g., solid support for immobilizing biomolecules in modern biosensor technology [3-5], optical sensing [6], surface enhanced Raman scattering (SERS) e.g., single molecule and single particle detection [7, 8]. Those applications will be needed appropriately properties of nanostructures that dependent on their sizes, shapes, compositions, and patterns. Nowadays, the anisotropic structures such as nanorod and nanowire [9], nanoplate [10, 11], octahedral [12, 13], nanostar, nanoflower, dendritic, branched [14-17], nanocage, and nanoframes [18, 19] was developed using any methods. The anisotropic structures have been created by seed-mediated method, polyol method, galvanic replacement reaction method, photochemical method, electrochemical method, template-mediated method and so on [20].

However, anisotropic nanomaterials cannot use fruitful applications, particularly SERS. Size and shape of the metal nanomaterials influence to SERS performance, enhancements process of SERS based on the field enhancement at sharp edges, corners, and interstitials of nanoparticles [21-23]. Assembly of anisotropic nanostructures as film could be increased an enhancement of SERS and changed optical property of nanomaterials [24, 25]. Furthermore, the galvanic replacement reaction was one of the methods that created complex structures as film.

In this work, methods for synthesizing complex gold structures including coral-liked gold nanostructures (CLGNs), needle-liked gold nanostructures (NLGNs) and standing coral-liked gold micro/nanoporous (CLGPs) by using galvanic replacement reaction were developed. The complex gold structures occurred after cleaning process. The gold structures derived from galvanic replacement reaction that could be controlled by various parameters *i.e.*, concentration of gold (III) ion, reaction time, additive ion. Furthermore, in this method we synthesized complex gold structures and controlled by AgCl precipitates and $AgCl_2^-$ as template as well as mobile template at ambient condition. Finally, the standing CLGPs were demonstrated an approach to detect low concentration of rhodamine 6G (R6G) dye and crystal violet (CV) using a small volume (1µL).

1.2 The objectives of this research

1.2.1 To develop the new method for synthesizing complex gold micro/nanostructures on silver surface via galvanic replacement reaction.

1.2.2 To study structural formation of complex gold structures due to the effect of Au^{3+} concentration, pH of Au^{3+} solution, reaction time and ultrasonic radiation.

1.3 Scopes of research

1.3.1 Developing a novel method for synthesizing complex gold structures.
1.3.2 Investigating the effects of gold (III) ion concentration, reaction time, chloride ion, and ultrasonic radiation on the structural evolution
1.3.3 Proposing the growth mechanism of complex gold structures.
1.3.4 Examining the SERS property of complex gold structures.

1.4 The benefits of this research

1.4.1 Novel method for synthesizing complex gold micro/nanostructures without capping agent and stabilizer is established.
1.4.2 Complex gold micro/nanostructures for SERS applications are manifested.