計畫編號：02

計畫名稱：層狀天然黏土分散奈米銀粒子新組成之安全性、抑制細菌生長機制及促進傷口癒合應用之研究

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計畫中文摘要：

本計畫擬開發一種新組成—以層狀無機矽土(smectite clay)包覆奈米尺寸銀粒子(Silver Nanoparticles or AgNP)之新穎材料，以作抗菌功能測試、機制探討、毒理安全評估，最終應用於皮膚燒燙傷及傷口醫療以及工業上、商業上之延伸。

奈米化銀粒子為近年迅速發展奈米材料之一，具重要之應用價值，包括醫藥(e.g., Silvazine* or silver sulphadiazine)、電子材料(例如RFID bar code)、導電零件(銀膠)、biosensor 等。但在製備時，奈米銀顆粒容易聚集以及無法有效的提高濃度，導致在後續的添加製程應用方面有很大的瓶頸。

本實驗已對天然黏土(clay)之高分子改質及應用累積多年研究經驗。本計劃擬以無機的黏土(包括 naturally occurring smectite clay such as Na+-MMT 及其他不同大小尺寸之 clays)以及新開發之奈米矽片(Nano Silicate Platelet, NSP)進行奈米銀的複合合成，開發出新的，有效的還原製程方法、奈米級分散及固定奈米銀顆粒。使用無機層狀黏土為分散劑，利用黏土表面的帶電性以及獨特的幾何形狀(thin platelet)來達到還原並分散。初步結果印證脫層黏土的奈米矽片，具有高比表面積以及強的電子性，可達到還原分散以及固定銀粒子的效果(粒徑~20 nm)。

本計畫擬對此帶有銀粒子之無機黏土及新穎奈米矽片，修飾延伸出無機/無機複合物奈米材料(clay/AgNP)；目標擬達到系列性具有不同親水及親油之奈米片狀材料--均勻分散於溶液態，高濃度凝膠態。利用這些奈米材料的高離子負電荷性、特殊幾何特性與有機親和性等之修飾，我們將探討這些新穎奈米材料的安全性，具抗菌性之作用機制以及促進皮膚傷口癒合生醫應用上之潛力，並期望開發出具有特殊抑制 MRSA 菌種之新材料的最終目標。

計畫英文摘要：

We propose to prepare a series of Clay/Ag nanoparticles as new materials and applications for antimicrobial/anti-infection agents and drugs for treating burn or wound skins.

Among the recent developments of nanotechnology, silver nanoparticle (AgNP) is one of important materials because of its widespread industrial applications, including biomedical (such as Silvazine), electronic devises (e.g., RFID bar code), conducting materials, and biosensors. However, the conventional methods for the AgNP preparation require tedious procedures in process and can only produce nanoparticle suspensions in low solid concentration (1-5%). The drawbacks have limited their applications in many areas.

For years, we have researched the clay/polymer interaction. To extend our previous works, in this proposal, we intend to explore the preparation of novel AgNP by using smectite clays (including Montmorillonite, Bentonite, Laponite, synthetic fluorinated mica and the exfoliated nanosilicate platelets NSP that discovered in our research group) for dispersing and stabilizing the fine silver particles. Our previous studies have prompted us to take the approach of using the layered inorganic silicate clays as the novel inorganic dispersing agent. In other words, the preparation of a highly stabilized, well-dispersed and concentrated AgNP solution is one of the goals for this project. The synthesized new materials will be applied for antimicrobial uses. The control of AgNP particle size in solution and in gel forms will be explored for the treatment of skin wounds. It is expected that the properties of high-aspect-ratio and ionic charges on the clay surface could provide a supporting effect for the fine AgNPs (expected 20 nm in diameter) and facilitate the high effectiveness for infection prevention. With the use of different clays, the mechanism of AgNP interaction with clay surface and interlayer space will be elucidated.

In the proposal, we further aim at the modifications of clay/AgNP hybrids in preparing into two forms—in solution, gel or paste at high concentrations, as well as studying their targeting properties. The novel

nanomaterial will be pursued of medical tests in treating genotoxicity, antimicrobial infection and burn or wound skins. It is highly expected that this development of new AgNP nanomaterial could lead to an insight mechanism when involving nanomarterials for the interaction of nanoparticles with cells in the biological system.