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CTCI Science and Technology Research Scholarship

電漿子奈米結構之製作應用於表面增強拉曼散射

Fabrication of Plasmonic Nanostructures for Surface-enhanced Raman Scattering Applications

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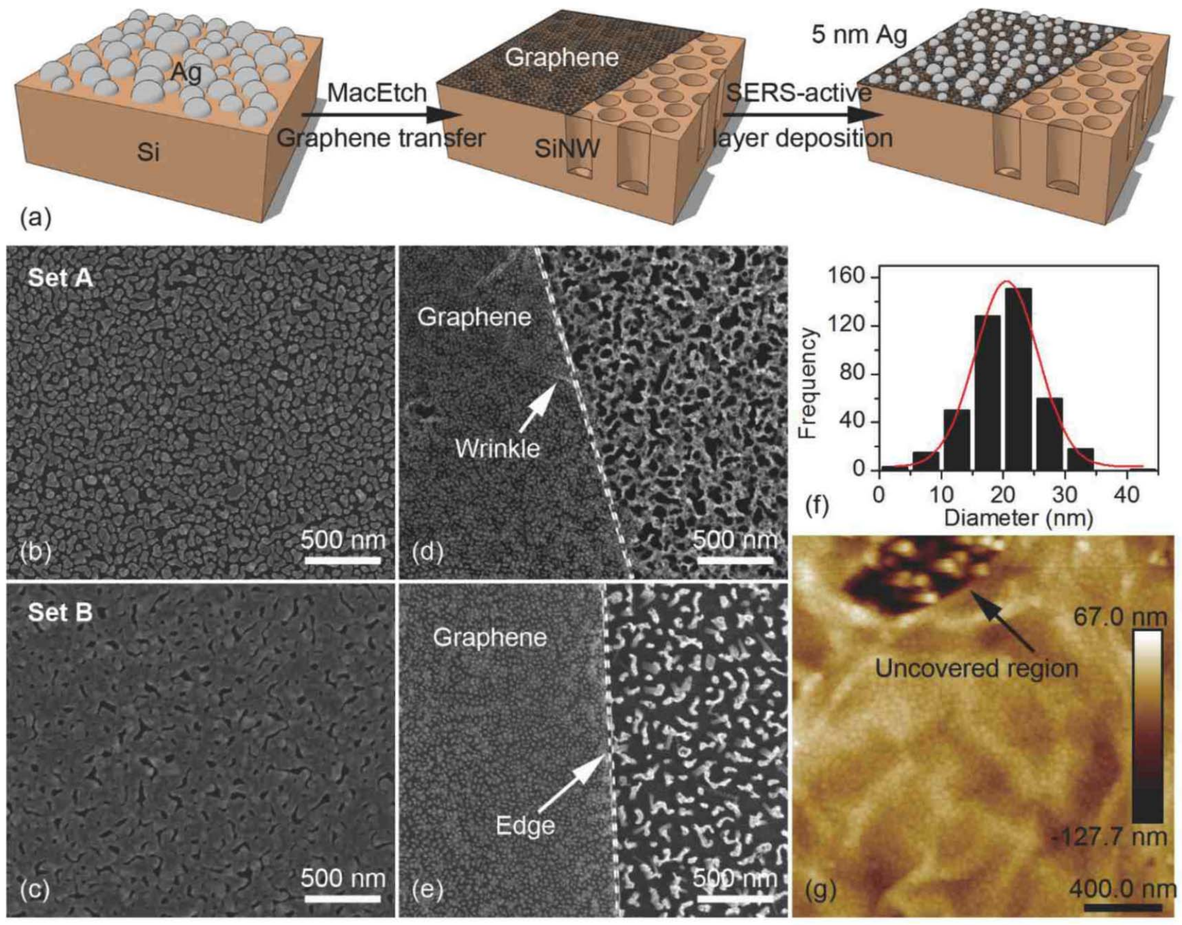
研究重點

The silver nanoparticle-decorated suspended graphene was fabricated to increase the efficiency of surface-enhanced Raman scattering (SERS). The morphology of cavity under the graphene was controlled by the thickness of catalyst and the etching time in the metal-assisted chemical etching process. For the samples treated with MacEtch, the Raman signals of graphene and *p*-mercaptoaniline were greatly enhanced due to the plasmonic cavity effect. With the optimal etching time of 15 sec, the SERS signals reached the maximum that was 13~15 times larger than those without etching. The electric field enhancement profiles and the SERS enhancement factor were simulated by finite-difference time-domain method to characterize the field distribution around the silver nanoparticles and to verify the enhanced SERS phenomenon observed in measurements.

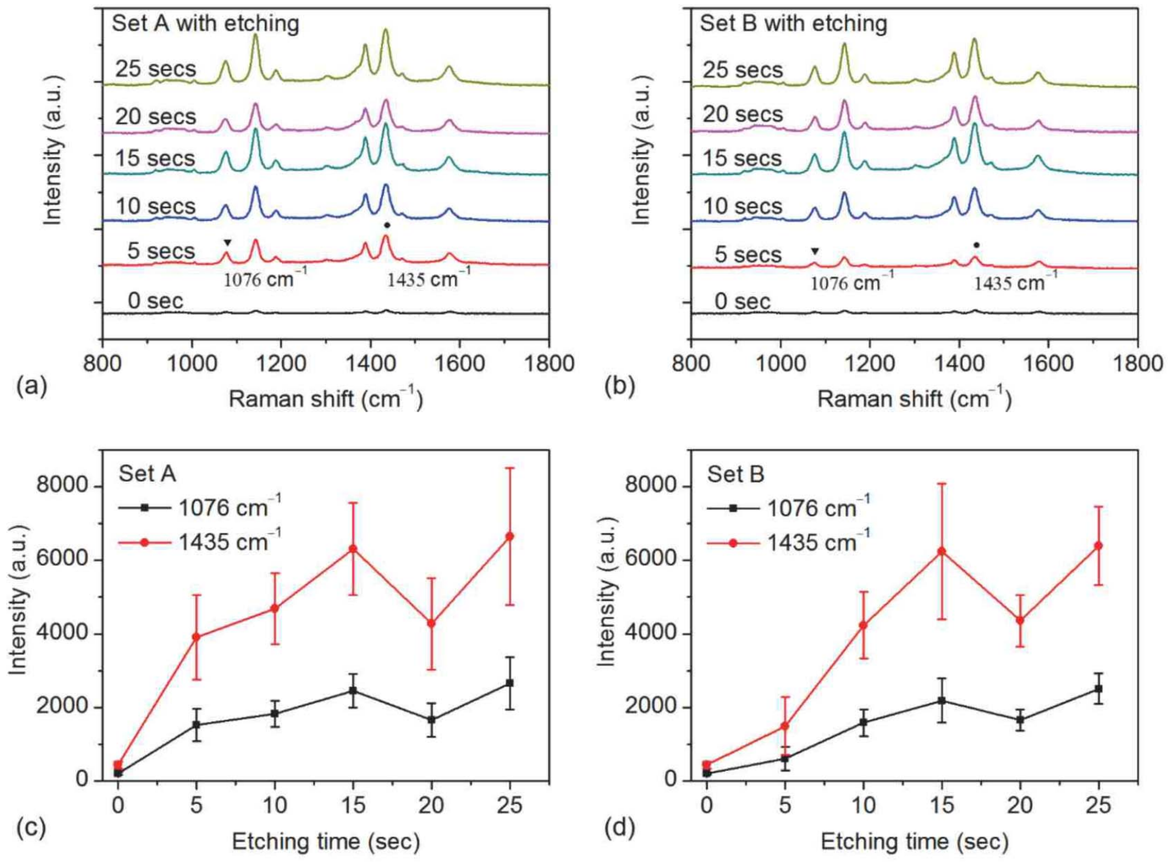
研究成果

FABRICATION



(a) Schematic diagram showing the process to fabricate silver nanoparticle-decorated suspended graphene. Ag catalysts deposited on Si substrate for (b) Set A of 5 nm thickness and (c) Set B of 10 nm thickness to form agglomerated nanoparticles. The SERS-active layers on the suspended graphene for (d) Set A and (e) Set B with 10-sec etching. The etching solution of $HF/H_2O_2/H_2O$ is defined by $\rho = [HF]/([HF] + [H_2O_2]) = 0.847$ and $[H_2O] = 46.6$ M at 25 °C. (f) The Ag particle size distribution of the SERS-active layer on graphene. (g) The AFM mapping of Set B with 10-sec etching.

SERS MEASUREMENT (*p*-mercaptoaniline (*p*MA))



The Raman spectra (baseline offset) of 10^{-4} M *p*MA for (a) Set A and (b) Set B with different etching time. The Raman signal intensity of 1076 and 1435 cm^{-1} vibration bands in *p*MA as functions of etching time for (c) Set A and (d) Set B.

研究生活及心得

研究所漫長卻又短暫的時光，讓我不斷地自我挑戰，不斷地超越自我，希望今天可以比昨天進步多一點點，種種的人事物不斷地衝擊我既有的觀念，讓我能夠迅速成長，感謝這段時間內與我有交集的每一個人，豐富我的生活，謝謝家人能夠全力支持與鼓勵，讓我平順地渡過每個時期的低潮，也要謝謝指導教授，放手讓我盡情發揮，因為有實驗室的大家，才能成就今日的我。謝謝中技社能給我肯定，未來我必定也會用同樣的態度回饋給社會。

財團法人 中技社 CTCI FOUNDATION