Uniaxial crumpled graphene structure as a spacer for improving plasmonic coupling

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Abstract

In this study, we investigated the plamon coupling across the multilayer graphene that acts as a spacer as well as the plasmon coupling between nanoparticles in the crumpled structure. It is widely accepted that plasmon coupling occurs though uniform and small gap because the strong enhancement of electromagnetic field is required to applying for the localized surface plasmon resonance (LSPR). Graphene has been studied as one of the good spacers because of its precise sub-nanoscale and uniform thickness. However, there are some problems that the thickness of a single layer graphene is extremely thin enough to allow quantum tunneling and the interparticle distance between top nanoparticles (or between bottom nanoparticles) is too large to induce comparable plasmon coupling as in the coupling through the graphene spacer. In order to block the shortcomings of single layer graphene spacer, we use multilayer graphene spacer instead of single layer, and try to combine the plasmon coupling through the multilayer graphene spacer with the crumpled nanostructure induced plasmon coupling to maximize the multi-coupling effects. We find that a uniaxial crumpled structure helps the plasmon coupling due to the reduction of its length scale. The coupling enhancement is found to be almost linearly proportional to shrinkage of the corrugated structure.

Reference

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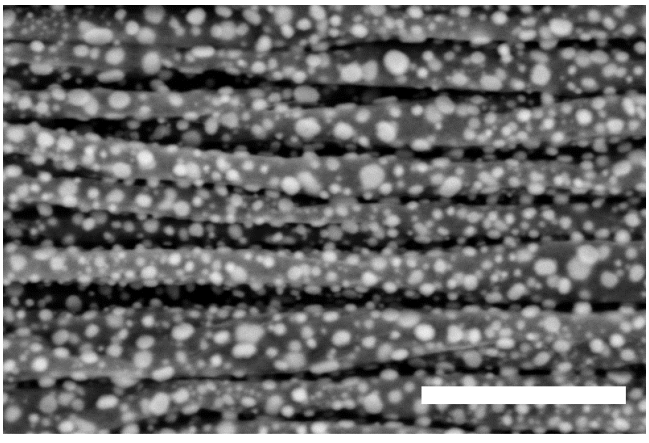
Figures



Uniaxial crumpled graphene with Au nanoparticles, Scale bar : 400nm