MASTER'S THESIS

Nano-metals plasmonic coupling

Cheng, Ka Ying

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ABSTRACT

In this work, we investigated nano-metal plasmonic coupling between dissimilar metals. We measured the optical transmission of nano-Ag coupled to other nano-metals using glass and Si substrates respectively. The reflected colors shifted from yellow to violet were obtained through the plasmonic coupling with nearest-neighbor nano-metals such as aluminum, magnesium, and ytterbium nano-metals. They were deposited randomly next to the nano-Ag. The metal size is from 8 to 15 nanometers. The results show that the colors changing is essentially due to plasmonic coupling between nano-Ag and another the nano-metals e.g. nano-Al The coupling caused a red shift in plasmonic resonance frequency, thus, changing the reflection color. The resonance shift agrees well with the simulation result using COMSOL. The inter-particle distance and particle size dependency of the optical spectra correspond to surface plasmon resonance extinction peaks for isolated nano-Ag and coupled with those neighboring nano-metals.

Due to plasmonic coupling between nanoparticles in small space can create new resonances; red shifts as the interparticle distance reduce. Wavelengths are tuned by the extent of the interparticles interactions which relate to the particles size, interparticles distance and the similarity of nano metals. Using different nano metals to fabricate thin films can change the plasmonic resonance frequency which makes the reflected colours become multihued.

When we look into the effect of the nano-particle size, and the distance between nano-particles, we discovered that larger nano-particle size has larger distance between the particles, and since the plasmonic coupling is a function of Inverse Square of the distance between particles. Therefore, smaller nano-particles have the strongest plasmonic coupling. Al produced the smallest nano-particle therefore it has the shortest distance between nano-Al and nano-Ag. Since the size of the particles can be controlled during deposition, the color changing of nano-Ag can be well defined. Thus tunable color changing devices can be fabricated.

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