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Development of Optical Nano Device Utilizing a Single-Crystalline Metal Film on NaCl(001) Substrate

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Summary

A new experimental technique is developed for producing a low-loss single-crystalline metal film on any substrate for use in plasmonics and metamaterials. This technique is based on the epitaxial growth of silver on a (001)-oriented single-crystalline NaCl substrate, which is subsequently dissolved in ultrapure water to allow the film to be transferred onto transparent and flexible amorphous substrates. Spectroscopic ellipsometry measurements indicated that the imaginary part of the dielectric constant of the single-crystalline film was smaller than that of a conventional polycrystalline film. Moreover, we used the finite-difference time-domain method to analyze the plasmonic properties of the nanoarray structure by considering the actual processed structure. The plasmonic performance of the single-crystalline silver nanostructure was largely determined by its structural precision and the dielectric properties of the metal.