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Optical reconfiguration and polarization control in semi-continuous gold films close to the percolation threshold

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1. Introduction

In this work we have studied the intrinsic and reconfigured optical properties of semi-continuous gold films, fabricated via a simple metal evaporation technique. We have prepared three films of nominal thicknesses 5, 6, and 7nm.

After fabrication the films are illuminated in areas by scanning a fs-pulsed laser over the films (Fig. 1). This results in permanent morphological changes in the films observed in a scanning electron microscope (SEM), see Fig. 2. The laser writing also introduces a polarized feature in the transmission spectra of the films.

We have performed electronic energy-loss spectroscopy (EELS) measurements and extensive fine-element simulations of our sample morphologies to better understand the origin of this polarization effect as well as the distribution of plasmonic resonances with and without laser writing.

From this we see that a strong dip in transmission appears when aligning the light source parallel to the writing laser.

During the transmission experiment it is possible for us to polarize the light source illuminating the sample, and we can then see that the wavelength position of this dip depends on the power and wavelength of laser light used.

2. Optical spectroscopy

After illuminating the gold films with different laser powers we performed bright-field transmission spectroscopy on the different regions, see Fig. 3.

To understand how these three processes influence the...