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Color Tunable Nanostructures by Polarization Control for Display Applications

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Surface plasmon resonance is the enhancement of electromagnetic wave caused by oscillation on the metal and dielectric interfaces. Surface plasmons with nanohole arrays provides an enhancedresonance for the specific wavelengths of interests. Asymmetric array of nanoscale structures can enable orientation dependent shift of resonance wavelengths when combined with the control of polarization for incident visible light, thus providing color tunability. Appropriate lattice constants along the direction of polarization in rectangular nanohole arrays can determine the resonance condition generating red (R), green (G), and blue (B) colors and potentially be applied to display applications. In ourprevious report, we have optimized the ion beam nanomachining conditions to fabricate the nanostructures on the metal film. We apply the fabrication conditions to make nanoscale hole arrays using 100 nm thick gold layer on the glass substrate with the optimal design of periodicities along x, y, and diagonal directions of a=440 nm, b=520 nm, c=682 nm, and the hole diameter of d=200 nm. Using the reflective light in dark field mode of optical microscope, we can observe different colors. When the polarizer is paralleled along a, b, or c direction, the represented color is changed to R, G, and B, respectively. We further map the color using i1 to correlate the conditions of the nanohole arrays with their characteristic color.

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