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Grating-coupled excitation and detection of surface plasmon polariton waves (SPPW) on Cu(111) using periodic density patterns of rare gas monolayers. YIYAN FEI, XU WANG, XIANGDONG ZHU, Department of Physics, University of California at Davis — Using periodic density profiles of xenon (Xe) as thin as $1 \sim 5$ monolayers, we have excited and detected grating-coupled surface plasmon polariton waves (SPPW) on Cu(111) in ultrahigh vacuum. The periodic density profiles are formed by laser-induced thermal desorption with a pair of coherent laser pulses at vacuum wavelength of 0.532 μm. The periodicity of the profiles is 5.45 μm. By illuminating the xenon-density-grating-covered Cu(111) with a converging He-Ne laser covering a span of incidence angles from 66.4° to 74.4° and detecting the oblique-incidence reflectivity difference $r_p/r_{p0} - r_s/r_{s0}$ vs. incidence angle with a multiple-element photodiode array, we observed the surface-plasmon resonance (SPR) peaked at $\phi_{SPR} = 70.4°$ with a full-width at half-maximum $\delta\phi_{SPR} = 0.29°$. From the resonance angle ϕ_{SPR} and $\delta\phi_{SPR}$, we have determined the optical dielectric constant of single crystalline Cu at 633 nm to be ε_{Cu} = -9.53 + i 0.142, markedly different from the literature values for evaporated Cu films. At elevated temperatures such that a xenon density grating on Cu(111) decays in contrast, the surface plasmon resonance as measured by $r_p/r_{p0} - r_s/r_{s0}$ diminishes, reflecting the kinetic of surface diffusion of xenon on Cu(111).

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