Nanostructured surfaces

Spectroscopy of thin copper layers on glass substrate with luminescence

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The paper presents the results of spectroscopic study of copper thin films on a glass substrate. Thin copper layers with electrical resistivity 7,8 and 10 Ω/cm^2 are obtained by electronical evaporation in vacuum at electric field strength E=60-80 V/cm. Raman spectra of the the glass substrate and a copper layer on it have a different shape at excitation of 630 and 785 nm. That shows the resonant nature of Raman process. The spectra shape of glass substrate is caused by luminescence of glass. The absorption spectra of copper thin films were obtained by Shimadzu spectrometer. These spectra have a minimum absorption at 560 nm due to plasmon effects and depend on film electrical resistivity. It is shown that smaller resistivity results in lower absorption level. Raman spectra of these films have specific characteristics that depend on film resistivity. Film with resistivity 8 Ω/cm^2, received in field strength E=74 V/cm, has the highest intensity ($75 \cdot 10^3$ a.u.) of Raman spectra with λ=1585 cm^{-1} and λ=1860 cm^{-1} wavelengths. Films with resistivity 7 Ω/cm^2 (E=80 V/cm) and 10 Ω/cm^2 (E=70 V/cm) have normal Raman spectra. This indicates that the resonance occurs in copper film with resistivity 8 Ω/cm^2, leading to increase of luminescence effects in glass substrate. The growth of luminescence intensity occurs due to the plasmon effects in copper film. Similar effects are detected for copper layers on substrates with resistivity level above 1000 Ω/cm^2. Raman spectra intensity was lower. The glass substrates with luminescence can be useful as substrates in plasmon sensorics. It is shown that the Raman spectrum shape and color of film is changing for ultra-thin copper films with resistivity level above 5 Ω/cm^2 under the influence of excitation light. This probably occurs due to structural changes in the copper film and its oxidation under the action of excitation light.