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Plasmon radiation from a silver surface during ion bombardment

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Continuous spectra of plasmon radiation from a Ag surface bombarded by 15 keV H^+, He^+, O^+ ions are investigated. The spectra in the region 200–600 nm are characterized by a broad maximum at λ = 330–360 nm depending on the experimental conditions. It is shown that the position of the maximum is very sensitive to the presence of oxygen impurities (0.001–0.05 of a monolayer) introduced either by adsorption or by implantation. The maximum position is sensitive also to ion flux and the type of bombarding ions (sputtering coefficient). This is suggested to be connected with a change in surface impurity concentration associated with a variation of ion beam parameters.

1. Introduction

Ion–photon emission (IPE) has been investigated in recent years as a method of surface diagnostics. Usually discrete lines of photon spectra connected with the radiation from scattered and sputtered particles are used for such diagnostics. Molecular bands found in spectra are also used in depth analysis of impurities[1]. Another component of IPE was observed recently, namely plasmon radiation from a surface. Broad continuous spectra (200–600 nm) were detected in ref 2 during bombardment of Ag surface by hydrogen and rare gas ions. The position of the maximum in the spectrum corresponds to plasmon oscillation of electrons in Ag. The agreement of angular energy and polarization characteristics of this radiation with those of plasmon radiation was also observed during electron bombardment of a Ag surface[3].

Plasmon radiation of silver (99.99%) is investigated in this work for 15 keV H^+, H_2^+, He^+, O^+, O_2^+ bombardment at a grazing angle of $\alpha = 30°$. The photon detecting system measures radiation in a direction normal to the ion beam.

2. Experimental procedure and results

In all experiments continuous spectra have a single maximum at 330–360 nm depending on the experimental conditions. Figure 1 shows examples of normalized spectra for H^+, H_2^+ and He^+ bombardment. Bombardment with H^+ ions is seen from Figure 1 to produce spectra shifted to the short wave region. It is found in ref 2 that the spectra obtained for He^+ bombardment resemble the spectra for Ne^+ and Ar^+ bombardment.

One may suppose that spectra variations under different experimental conditions are connected with the surface purity. The influence of gaseous oxygen adsorption and oxygen ion bombardment are investigated in this work. Figure 2 shows the spectra obtained for high flux H_2^+ bombardment with and without gaseous oxygen in the vacuum chamber. Also shown is the spectrum for O_2^+ ion bombardment. One may see that H_2^+ ion bombardment in Figure 2 (high ion flux) is shifted in comparison with that in Figure 1 (low ion flux) towards the spectrum obtained for He^+ bombardment. This result appears to be in agreement with the suggestion that there is a surface cleaning effect associ-

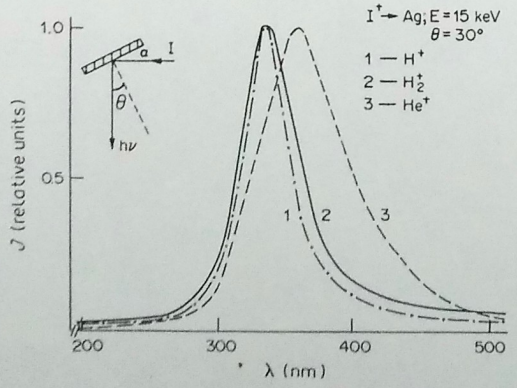

Figure 1. Normalized ion–photon emission spectra obtained for bombardment of a Ag target at a grazing angle $\alpha = 30°$ by H^+ (1), H_2^+ (2), and He^+ (3) ions with an energy of 15 keV.

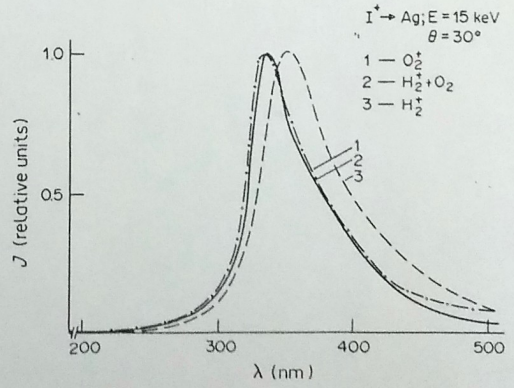

Figure 2. Normalized ion–photon emission spectra obtained for bombardment of a Ag target at a grazing angle $\alpha = 30°$ by O_2^+ (1), H_2^+ with gaseous oxygen inlet (2), and H_2^+ (3) ions.