Letter to the Editor

APPLICATION OF OPTICAL EMISSION SPECTROSCOPY FOR MONITORING THE DEPOSITION PROCESS OF METAL-DOPED POLYMER FILMS[1)]

ПРИМЕНЕНИЕ ОПТИЧЕСКОЙ ЭМИССИОННОЙ СПЕКТРОСКОПИИ ДЛЯ МОНИТОРИРОВАНИЯ ПРОЦЕССОВ НАНЕСЕНИЯ ТОНКИХ ПОЛИМЕРНЫХ ПЛЕНОК С ПРИМЕСЯМИ МЕТАЛЛА

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Metal-doped polymer films have been intensively studied during the past few years [1]. The metal contents in the polymer may be arbitrarily varied, which results in substantial changes in conductivity and optical transmittance of the layers [1, 2]. It has been shown that the method of metal incorporation (evaporation, sputtering and co-sputtering) has no significant effect on the film characteristics [1].

Thin films were prepared simultaneously by plasma polymerization of halocarbons (CF_4 and C_2F_3Cl) and sputtering of metals (Au and Al) or co-sputtering (Au + polytetrafluoroethylene) in an r.f. (20 MHz) glow discharge excited by a planar magnetron. The deposition system is described in more detail in Ref. [1]. The optical emission spectroscopy was used for monitoring the deposition process. The light emitted from the plasma region passed through a quartz window, was focused on the entrance slit of a monochromator (SPM-2, Zeiss) connected with a photomultiplier (1P28, RCA) and a chart recorder (K101, Zeiss).

In the case when gold was incorporated in the presence of a halocarbon monomer, the emission spectrum was monitored in the vicinity of the intensive gold emission line at 267.6 nm and the radical CF_2 band emission head near 265 nm (see Fig. 1). The I_{Au} and I_{CF_2} emission intensities at 267.6 nm and 265.2 nm, respectively, repesent the gold concentration in the plasma volume and the rate of plasma polymerization.

Comparing the Auger electron spectroscopy analysis of the obtained layers [1] with the emission intensities I_{Au} and I_{CF_2} it can be concluded that the ratio I_{Au}/I_{CF_2} may be used as a processing parameter characterizing the filling factor of the composite films. The I_{Au}/I_{CF_2} ratio has been recently put into connection with the electrical properties of the layers [3].

The vicinity of line emission intensities at 396.2 nm (Al) and at 420.1 nm (Ar) was monitored during the sputtering of an aluminium target in argon (see Fig. 2). After adding the C_2F_3Cl monomer to the working gas an abrupt decrease in the I_{Al}/I_{Ar} emission intensity ratio was observed. On the other hand, when the CF_4 monomer was added to argon, the I_{Al}/I_{Ar} ratio decreased only after a critical value of the

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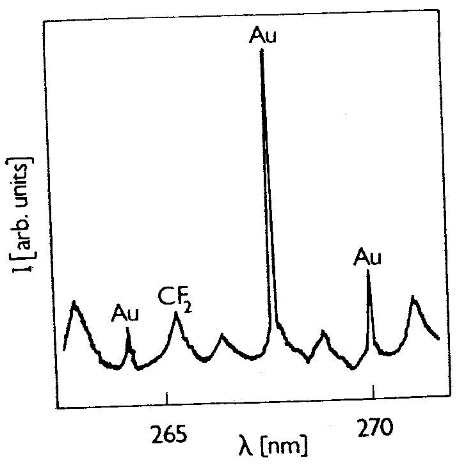

Fig. 1. Typical part of the emission spectrum for a C_2F_3Cl monomer and gold target at the power of 60 W and pressure of 1 Pa.

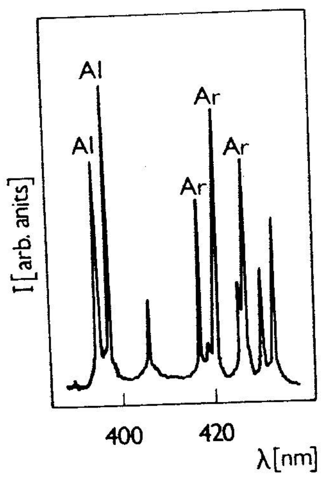

Fig. 2. Typical part of the emission spectrum for argon and aluminium target at the power of 100 W and pressure of 1 Pa.

CF_4 concentration had been reached. The decrease in the I_{Al}/I_{Ar} ratio indicates the reduced sputtering of aluminium, which is confirmed by the resistivity changes of the obtained films.

Optical emission spectroscopy can be thus used, after calibration, as a convenient technique for controlling the deposition process of composite metal-doped polymer films.

REFERENCES

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