UNBALANCED MAGNETRON SPUTTERING WITH ADDITIONAL MAGNETIC FIELD ENHANCED CONFINEMENT*

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Magnetron sputtering has been used for depositing thin films and surface modification over the last decades because of its high rate, ease of scaling and the quality of the deposited films. Two basic configurations of magnetron sputtering can be distinguished: balanced magnetron sputtering (BMS) and unbalanced magnetron sputtering (UBMS)[1]. On the basis of UBMS, improved technology had been developed[2] to confine the discharge plasma further.

In this paper, with three additional magnetic rings being assembled outside the discharge room and connected with the magnetic field of the conventional unbalanced magnetron sputtering, a closed magnetic field configuration distribution had been formed in the whole discharge room and which can confine discharge plasma more effectively. Ion density in the discharge plasma was diagnosed by Langmuir probe and the optical emission line intensity ratios of Cu+/Cu were studied by optical emission spectroscopy. The structure and morphology of the Cu films were measured by atom force microscopy. A comparative study of the new magnetic field configuration with the conventional unbalanced magnetic field configuration was conducted. The results showed that the application of the additional magnetic field could increase the ion density about a factor of one point eight and enhance the ionization degree of the sputtered Cu effectively. The deposited copper films had smaller crystal grain size and smoother surface when the additional magnetic field was applied.

1. P. J. Kelly, R. D. Arnell, “Magnetron sputtering: a review of recent developments and applications”, Vacuum 56(2000) 159-172.
2. J. Musil, K. Rusnak, V. Jezek, J. Vlcek, “Planar magnetron with additional plasma confinement”, Vacuum 46(1995)341-347.

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