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Modelling of an RF-IPVD magnetron discharge for deposition of Cu thin films.

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Thin film deposition by magnetron sputtering is usually improved, in terms of film quality and properties in terms of usage, by various techniques which are developed to enhance the ionization of metal vapour. HiPIMS technique gives good results for deposition of metallic and compound films[1] but it may cause substrate degradation for deposition on thermo-sensitive materials as polymers. In parallel with experimental study of an Inductively RF assisted magnetron discharge used for Cu thin films deposition on polymers[2]. The understanding of the role of the plasma particles contributing to film properties remains pending. A Collisional Radiative Model (CRM) would contribute to answer this question.
The discharge CRM we developed contains two coupled parts: i) for the primary magnetron plasma, a CRM was adapted from previous works[3]. We introduced target sputtering and Cu vapour injection and a detailed description of the Cu* states including metastable ones suspected to play a major role in the discharge. Outputs are the fluxes of electrons and Cu atoms and long-life species (Ar* and Cu* metastables); ii) for the RF plasma part, we consider the flux of energy-degraded electrons diffusing from the magnetized negative glow[3]; these electrons are heated by the E-field associated by the RF power which amplify ionization. Electron and ion losses on conductive walls and floating substrate are considered, effects of self-absorption of emission lines too. Comparisons between model and experiment are made for various conditions (pressure, magnetron and RF powers) through i) optical emission and absorption data with CRM results for excited and ion densities, ii) Langmuir probes measurements for plasma parameters (ne, Te, Vp Vf) with model outputs. Results are used to evidence the main species contributing to the film deposition and its quality.
1. V Kouznetsov et al, SCT 122 (1999) 290
2. I Guesmi et al, this conference
3. F Guimarães & J Bretagne, PSST. 2 (1993), 127

Keywords
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