

GROM2-K1-130A COMPARATIVE STUDY OF METAL OXIDE AND METAL OXIDE/SILICA THIN FILMS DEPOSITED BY LP MICROWAVE PLASMA PROCESS FROM METALORGANIC PRECURSORS (ZIRCONIUM TETRA TERT-BUTOXIDE AND TITANIUM TETRA ISOPROPOXIDE).

GROM - Thin films growth and modelling

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In this work, metal oxide and metal oxide/silica « composite » thin films were obtained by PECVD in multi-dipolar ECR Plasma reactor from gas mixture composed of oxygen gas and metalorganic precursors [1]. [Zirconium (IV) tert-Butoxide (ZTB, $ZrO_4C_{16}H_{36}$) and Titanium (IV) isopropoxide (TTIP, $TiO_4C_{12}H_{28}$)]. In the first part of the work, the study focuses on thin film characteristics as a function of O_2 /precursor ratio. As O_2 /precursor ratio increased, analysed properties evolve similarly in both zirconium and titanium oxide films. Composition of the films progresses from organic to almost inorganic with the addition of oxygen to plasma gas mixture. The growth mode evolves from homogeneous to columnar in highly oxidized plasma. From a fundamental point of view, columns obtained experimentally in ZTB and TTIP were compared with those obtained by theoretical simulation (Monte Carlo method) [2] in order to understand the observed morphological differences (column width). Further, we investigated the influence of the total gas pressure of plasma gas mixture composed of O_2 (95%)/metalorganic precursor (5%) on thin film growth. Chemical composition of the films does not change drastically with the increase in pressure. In the case of ZTB, total gas pressure has a strong influence on the morphological characteristics: columnar growth disappears at pressures above 8 mTorr. This phenomenon was not observed in films deposited in TTIP plasma.

In a third part we have demonstrated the possibility of synthesising $ZrSi_wO_xC_yH_z$ and $TiSi_wO_xC_yH_z$ homogeneous thin composite films by simultaneously introducing a metalorganic precursor and an organo-silicon precursor Hexamethyldisiloxane (HMDSO, $OSi_2C_6H_{18}$) into the reactor. Increase in the fraction of HMDSO in the plasma gas mixture induces a change in growth mode from columnar growth mode (low HMDSO content) to uniform growth mode (higher HMDSO content). This work has highlighted the various possibilities of obtaining a large panel of thin film properties in terms of density, optical index and porosity.

Keywords:

low pressure PECVD, Thin films, ZTB, TTIP, HMDSO, metal oxide, metal oxide/silica,

References

- [1] R. Cozzolino, Y. Segui, P. Raynaud "Characterization of thin film deposited with MMP DECR reactor from Zirconium tert-Butoxide precursor", Surface & Coatings Technology 205 (2011) S198–S203
- [2] R. Alvarez, P. Romero-Gomez, J. Gil-Rostra, J. Cotrino, F. Yubero, A. R. Gonzalez-Elipe and A. Palmero, "Growth of SiO_2 and TiO_2 thin films deposited by re-active magnetron sputtering and PECVD by the incorporation of non-directional deposition fluxes", Phys. status solidi, vol. 210, no. 4, pp. 796–801, Apr. 2013.