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STRUCTURAL AND DISCHARGING PROPERTIES OF MgO THIN FILMS PREPARED BY PULSED LASER DEPOSITION

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Polycrystalline MgO layer with typical thickness of 500 nm have two major functions in plasma display panels (PDPs). Firstly, this film protects the dielectric layer deposited onto the electrodes from plasma erosion due to gas discharge. Secondly, it ensures the favourite energetic conditions for discharge. Some of the actual problems that concern PDPs presently are relatively short lifetime and high electric power consumption. The key elements to overcome these disadvantages are the increase of the sputtering resistance against ion bombardment and the reduction of the discharge voltage.

Previously MgO layers were made mainly by electron beam deposition (EBD) method and also by various sputtering techniques. For studying possible replacement materials for currently used MgO, it is useful to apply a suitable deposition method for materials engineering and research. PLD is a method that not only produces high quality films but is very versatile at the same time – combinatorial deposition, ability to transfer complex stoichiometry from target to film, easy to deposit layered structures with the use of multiple targets.

In this work, 200-250 nm thick MgO films were deposited by pulsed laser deposition (PLD) method on fused silica substrates and on special electrode substrates for firing voltage (FV) measurements. High quality MgO single crystals grown by the arc-fusion method were used as targets. PLD deposition parameters of the films were as follows: excimer laser wavelength 248 nm, laser pulse energy density on the target ~7 J/cm^2, substrate temperature (T) 260 – 600 ^{o}C, and oxygen pressure (p) in the chamber 2*10^{-4} - 5*10^{-2} mbar. Structural and morphological characterisation of the films was performed by XRD, XRR, and AFM. The results were compared to the data of FV measurements.

Discharge and structural properties of the samples were strongly dependent on PLD growth parameters. At a fixed temperature, the crystallinity and density of the films were higher when oxygen pressure was lower. At a fixed oxygen pressure, the crystallinity and density of the films increased with increasing substrate temperature. Surface roughness of the films increased with increasing oxygen pressure and substrate temperature. Practically all crystalline samples obtained were highly (200) oriented and showed only one reflection at 2Θ = 43 deg. It has been reported that EBD grown (200) oriented MgO films are more resistant to ion sputtering as compared to (111) oriented films. FV values were correlated with structure properties and surface morphology of the samples. At a given substrate temperature, lower FV values were obtained for the films grown at lower oxygen pressures. At a fixed oxygen pressure, the FVs of the samples decreased when substrate temperature increased. Samples with the lowest FV values had high crystallinity and density close to theoretical value of bulk MgO (3.58 g/cm^3), but moderate surface roughness.