Proposition for a poster presentation

EFFECT OF LOW RF BIAS POTENTIAL ON AlN FILMS OBTAINED BY PLASMA ENHANCED CHEMICAL VAPOR DEPOSITION

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Aluminum nitride is one of the most investigated piezoelectric materials for the manufacture of acoustic wave devices due to its high acoustic velocity and fairly large piezoelectric coupling coefficient. Single crystal properly oriented films would be the ideal choice for these applications; however, high quality polycrystalline preferentially oriented films can be used with good success. Minimal film surface roughness is required to reduce acoustic losses in surface acoustic wave devices. The reduction of residual stresses is important in order to assure film integrity as well as to avoid non desired deformations in Micro-Electromechanical Systems (MEMS) applications.

We have previously informed the deposition of polycrystalline <0001> oriented AlN films by a Microwave – Plasma Enhanced Chemical Vapor Deposition (PECVD) technique, using no RF bias, with the substrate holder at the floating potential. The resulting films showed tensile residual stresses, which were partly associated to thermal residual stresses derived from the process substrate temperature at the optimal deposition conditions (700°C). With this setting, thicknesses thinner than 1 µm could be deposited with adequate microstructure, but, for higher thicknesses, cracked films were obtained.

In this study, AlN films were prepared with a Microwave Plasma Enhanced Chemical Vapor Deposition reactor at 1 Pa and 700°C using different radiofrequency bias , i.e. different energy ion bombardment, in order to obtain polycrystalline <0001> oriented films with minimal residual stresses for piezoelectric applications. The films developed were characterized in term of microstructure, composition and mechanical properties. Crystalline development, exclusive orientation and high tensile residual stresses were observed when the substrate-holder was at the floating potential. A progressive degradation of the crystalline structure was observed with the increase of the negative bias potential together with the evolution to compressive residual stresses. Simultaneously, significant changes in the microstructure of the surface were observed by atomic force microscopy, as well as in the preferential orientation from <0001> to <10$\underline{1}$0>. The adequate selection of bias potential allowed optimizing film properties for piezoelectric applications.