Bin Li, J Material Sci Eng 2018, Volume 7
DOI: 10.4172/2169-0022-C2-095

Stress modification in praseodymium fluoride thin films through admixture with barium fluoride

Bin Li
Shanghai Institute of Technical Physics, Chinese Academy of Sciences, China

Although some rare-earth fluorides were currently used in infrared antireflection as low-index evaporation materials in order to substitute for radioactive thorium fluoride (ThF_4), the higher tensile stress presented in the layers will deteriorate the reliability and durability of the interference multilayers. Stress in the layers significantly influence not only the mechanical performance of interference multilayers such as thermal cycling life and fatigue properties but also their optical behaviors due to cracking or interfacial delamination. Most importantly, any bending or deformation of the substrate caused by stress will also affect the performance of the antireflection coatings. Therefore, the relief of the stress in the layers is a critical process.

The stress in the film after the deposition process is the sum of three different types of contributions. First, there is the intrinsic stress evolving in the layer during deposition. Secondly, the thermal stress appears during the cooling process, caused by a mismatch between the coefficients of thermal expansion of the substrates and the materials deposited. Finally, the adsorptive stress occurs once the finished coating is open to air with the adsorption of moisture and impurities. The magnitude of stress can vary depending on the conditions of deposition.

Since the substrate materials, deposition process, moreover, the difference between the deposition temperature and the ambient temperature, were completely controlled to be identical, only the contribution resulting from intrinsic stress is basically related to the chemical composition of the films.

In our investigation, a new infrared low-index evaporation material, the admixture of praseodymium fluoride (PrF_3) with barium fluoride (BaF_2) was exploited. The stresses in thin films deposited on Si strips using electron beam evaporation from the sintered pellets of PrF_3 admixed with a different amount of BaF_2 were measured. It is disclosed that the stresses in the layers of PrF_3 can be greatly reduced with the increasing amount of BaF_2 in thin films.

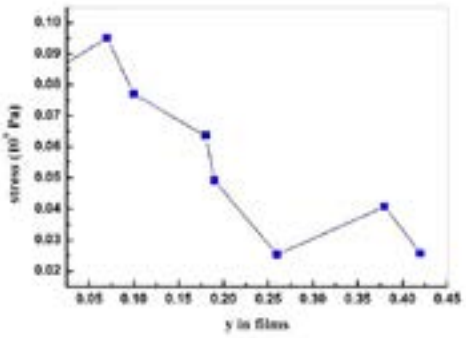

Fig. Measured intrinsic stress of PrF_3 -BaF_2 thick films composition as a function of BaF_2 concentration

Biography

Mr, Bin Li is a Senior Scientist in Shanghai Institute of Technical Physics, Chinese Academy of Sciences. His research focuses into infrared coating materials and infrared-transmitting materials, including rare-earth fluorides, oxides and narrow gap semiconductors Mr, Bin Li is a Senior Scientist in Shanghai Institute of Technical Physics, Chinese Academy of Sciences. His research focuses into infrared coating materials and infrared-transmitting materials, including rare-earth fluorides, oxides and narrow gap semiconductors.

binli@mail.sitp.ac.cn