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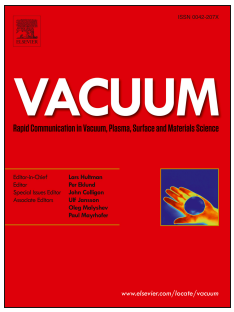


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PII: S0042-207X(17)31382-9

DOI: 10.1016/j.vacuum.2017.11.018

Reference: VAC 7687

To appear in: *Vacuum*

Received Date: 4 October 2017

Revised Date: 9 November 2017

Accepted Date: 10 November 2017

Please cite this article as: Liu H, Wang L, Jiang Y, Li S, Liu D, Ji Y, Zhang F, Chen D, Study on $SiO_2$ thin film modified by post hot isostatic pressing, *Vacuum* (2017), doi: 10.1016/j.vacuum.2017.11.018.

# Study on $SiO_2$ Thin Film Modified by Post Hot Isostatic Pressing

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Abstract: $SiO_2$ thin film is one of the important low refractive index films commonly used in the field of optical thin films. In this paper, the Hot Isostatic Pressing (HIP) technique is applied to the post-treatment of $SiO_2$ thin film materials for the first time. The thin film samples were prepared by ion beam sputtering deposition technique. The sample was heated at 300 ℃ for 50 MPa under vacuum argon atmosphere for 24h. The samples were analyzed by the spectral of the visible and infrared bands and surface deformation. The effects of HIP treatment on the refractive index, physical thickness, stress, Si-O-Si bond angle and relative density of films were obtained. The results show that the refractive index decreases from 1.4685 to 1.4591, the physical thickness increases 0.6%, the stress changes from -493MPa to -226MPa, and the Si-O-Si bond angle increases from 129.85° to 131.32°. The fundamental physical mechanism of all the characteristics change is the film stress. The release of film stress leads to the decrease of the density of the film, and the variation of the thin film density is proved by the change of asymmetric stretching vibration frequency of $SiO_2$ thin film. In addition, the HIP treatment can reduce the OH-group chemical defects in the $SiO_2$ thin film.

**Keywords**: $SiO_2$ thin film, ion beam sputtering, modification, hot isostatic pressing

## 1 Introduction

$SiO_2$ thin films are one of the most important low refractive index materials in the field of optical thin films.The films with low absorption, amorphous structure, high thermal stability and corrosion resistance are widely used in the design of various optical multilayer films such as antireflective film, high-reflective film, spectral film, optical filter film and other optical components. $SiO_2$ thin films are prepared by thermal oxidation, thermal evaporation, ion assisted deposition, ion beam sputtering, magnetron sputtering, plasma enhanced chemical vapor deposition, sol-gel and pulsed laser deposition [1-7]. Due to the strong non-equilibrium physicochemical process, the composition, density, porosity, crystal structure, refractive index and extinction coefficient of $SiO_2$ thin films are changed. The post-processing methods can effectively enhance the performance of the $SiO_2$ films [8,9],