CONTROL OF THE DUAL ION BEAM DEPOSITION PROCESS TO PERFORM LOW-LOSS MIRRORS.

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Abstract

In recent years an increasing number of optical devices and experiments are shown to be limited by the physical properties of the materials used to perform the mirrors, filters... In particular sub-Hertz laser frequency stabilization and gravitational wave detectors, that are able to measure fluctuations of 1e-18 m/sqrt(Hz) or less, are being limited by thermal noise and optical absorption in the dielectric coatings deposited on substrates. Today, the dielectric materials SiO2 and Ta2O5 are the most commonly used. At the LMA, we study Ta2O5 thin film, which is the most limiting material, with the goal to reduce the mechanical losses, absorption and diffusion as low as possible. Low losses mirrors are made using the classic technique of ion beam sputtering (IBS) to coat the mirror substrate. To improve the coating optical properties, we act on the IBS process parameters. First, we will present a study on the main ion beam sputtering source. We have modified the main source to measure the current of the decelerator grid (Idec). The influence of the main source parameters (Va, Ia, Vb...) on Idec have been studied. In the second part we show the result of an investigation on the optical (index of refraction, absorption...) and mechanical (mechanical losses, quality factor) properties of the coating with different deposition parameters of an ion beam assistance source (energy, current...). The correlation between theses physical properties and the deposition parameters will be discussed.

Keywords: ion beam sputtering, mirrors, optic, dielectric materials, gravitational wave

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