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Dielectric coatings for optical application using reactive ion beam sputtering

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The requirements for optical coating have strongly increased with the advancement made in high-power LASER technology and optical applications. Therefore ion beam sputtering of such coatings became the favorable deposition technique, since the high energy particles arriving at the substrate reveal very smooth and dense films. Usually, stacks as anti-reflex coatings and optical mirrors consist of alternating high and low index dielectric layers. As low index material SiO_2 is commonly used and for high index several candidates as Ta_2O_5, ZrO_2 or HfO_2 are suitable.
In this work, dielectric coatings are deposited using ion beam sputtering. As low index material SiO_2 is used, while for high index different oxides were investigated. The films are sputtered reactive by an Ar ion beam from a metallic target. The substrate holder allows to change the incidence angle of the incoming atoms, what can be used to tune the film properties and to deposit on non-planar substrates. The thickness of the layers is controlled by an optical monitor. Hereby, complex stacks up to 200 layers can be deposited by an integrated test glass changer allowing reloading test glasses without venting the chamber. To deposit optical coatings, knowledge of the exact properties of the single layers is essential. Therefore the single layers are characterized regarding stoichiometry, deposition rate, homogeneity, contaminations und optical properties. The relation between the obtained stoichiometry, the refractive index and the used oxygen flow will be discussed. Furthermore, the difference between using oxygen background gas, using oxygen plasma or using an assisting oxygen ion beam are presented. Furthermore, specific multilayer coatings as for instance high-reflective mirrors and transmission filters were deposited. Their performance is characterized by the corresponding transmission and reflection spectra, by measuring the film absorption and by determination of the laser damage threshold.

Keywords
dielectric films
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metall oxides