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Interplay between microstructure and chemical oxidation states in SiOx optical thin films and multilayers

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This work shows the the stoichiometry and nanostructure of reactively sputtered SiOx thin films can be independently controlled by adjusting the O_2 flow and the deposition angle during deposition. Using this parameter as an additional working variable for controlling the deposition process has permitted the fabrication of thin films with similar/different nanostructure and density and different/similar distribution of oxidation states from Si^{4+} to Si^0. A large variety of thin films with variable composition (i.e., from x=0.2 to x=2) and nanostructure (from nanocolumnar to homogeneous and a rich variation in density values) have been preapred using the proposed procedure and thoroughly characterized by a large set of methods including RBS, XPS, SIMS, AFM or FT-IR. Moreover, the tight relationship found between the films optical and electrical properties and their chemical and microstructural characteristics has permitted to develop a large family of layers and multilayers with a precise optical response in the IR region by independently adjusting composition and microstructure. The possibilities of these materials for the fabrication of different photonic elements for light control in the near-IR part of the spectrum are illustrated with the fabrication of multilayers in the form of Bragg reflectors, Bragg microcavities and other similar structures. The methodology employed for the fabrication of these complex structures relies in a programmed control of the orientation of the substrate during deposition and is proposed as a general and versatile procedure for the fabrication of other layers and multilayers of compund thin films (e.g., nitrides, oxides, carbides, etc.)

Keywords
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