Towards facile fabrication of photonics components from inorganic and hybrid sol-gel films. Preparation and optical properties characterization

Autorzy

Łukasz Duda

Maciej Czajkowski

Paweł Karasiński

Cuma Tyszkiewicz

Magdalena Zięba

Małgorzata Guzik

Rok wydania

2022

Czasopismo

Ceramics International

Numer woluminu

48

Strony

29676-29685

DOI

10.1016/j.ceramint.2022.06.225

Kolekcja

Naukowa

Język

Angielski

Typ publikacji

Artykuł

Streszczenie

New trends towards development of integrated optics and miniaturization of photonic devices require fabrication of miniaturized photonic components. Fabrication of waveguiding films with designed optical properties is a fundamental process for production of planar integrated devices.

We report here preparation of thin layers based on TiO_2 precursor (TET – titanium(IV) ethoxide) and SiO_2 precursors, namely inorganic (TEOS – tetraethyl orthosilicate) or organically modified (GLYMO − 3-glycidoxypropyltrimethoxysilane) as candidates for potential application in the planar integrated circuits.

The thin layers were deposited on soda-lime glass substrates using the sol-gel method and dip-coating technique and processed at relatively low temperature (up to 300 °C). Several parameters e.g. a) the type of SiO_2 precursor, b) the presence of complexing agent for TET and c) heat treatment temperature were tested for their influence on thickness and refractive index of the obtained films.

Furthermore, a few series of sol-gel films activated with luminescent dye (Rhodamine B) was fabricated. The influence of the above-listed parameters on luminescent properties of the films was characterized because of lack of systematic study in the literature in this aspect. Moreover, a spectrum of the light at the output of a chosen luminescent dye-doped waveguiding film excited by laser source was investigated.

In addition, the subject of our investigations were films prepared at 200 °C with various amounts of TET and organically modified SiO_2 precursor in concentration range not presented before. Their optical properties such as homogeneity and values of optical band gap of TiO_2 clusters were explored. For selected samples the waveguide properties including the optical losses were evaluated. For the first time, hybrid films with presented composition and refractive index in range of 1.59–1.71 were used for patterning by nanoimprint technique allowing for reproduction of periodic structures, which may serve for example as grating couplers or DFB (distributed feedback) resonators.

Słowa kluczowe

Sol-gel method, Silica-titania films, Organically modified GLYMO precursor, Optical properties, Waveguides

Adres publiczny

http://dx.doi.org/10.1016/j.ceramint.2022.06.225

Strona internetowa wydawcy

http://www.elsevier.com