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Derivation of coupling coefficients and grating thickness, and control of spectral and angular bandwidths concerning volume phase gratings with a variety of refractive index distributions

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Abstract

The equations for the coupling coefficient and the grating thickness of volume phase gratings are derived from Maxwell's equations in this work. The equations cover all graded types of refractive index distributions (RIDs) which change continuously from a triangular type to a rectangular type in the Bragg regime. The functions expressed as various graded types of RIDs, which are proposed in this work, are used among them. Furthermore, the new idea, which is the correlative coupling-length coefficient, is devised for the first time as a variety of RID function, "G-factor". The results based on the coupled-mode theory in this work show a very close agreement under 0.2 % with the results of the rigorous coupled wave analysis method. The values of the grating thickness and the G-factor are confirmed with validity. It becomes clear that the spectral bandwidth (λ_{FWHM}) and the angular bandwidth (θ_{FWHM}) can be controlled by the refractive index modulation which is the same value as with the G-factor. The energy envelopes overlap perfectly and agree well with even the side-robes for a variety of RIDs. By means of this new method, not only can the grating thickness of any graded type of VP-grating which is under the Bragg condition be obtained very easily, but the spectral bandwidths and the angular bandwidths which are not under the Bragg condition can be controlled very easily and the configurations of RIDs can be estimated as well.

Biography:

Kaoru Nakajima has received her Bachelor's degree from Japan Women's university in 1991. She was a researcher at Fujitsu labratory LTD in Japan for over 13 years, where she was engaged in researching semiconductor lasers, design of LSI, POF transmission experiment using LN external modulator, and biosensors. She has received M.S. degrees in 2007 from Japan Women's university. She has been in a doctoral course from 2007 to 2010, and from 2013 to 2019 at Japan Women's university. Her current researches are related to VP-gratings. She is a member of OSA and SPIE.

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