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Generalized Dispersion Equations for Nonlinear Waveguides with Kerr-type Films

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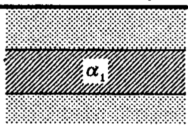
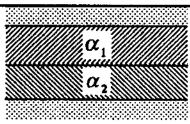
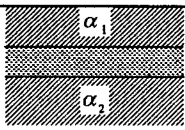
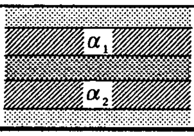
We present a novel, generalized nonlinear dispersion equation[1] for various nonlinear waveguides with Kerr-type films. The analytic form of nonlinear dispersion equations has been derived by using the relation between the interface fields. The "generalized" means that the equation can represent most of nonlinear waveguide structures with up to five linear and/or nonlinear layers. For example, we apply the generalized dispersion equation to 4-types of nonlinear waveguide structures[2]: I)the waveguides with a nonlinear core layer, II)the waveguides with two nonlinear core layers, III)the planar structures having a linear core with nonlinear surrounding media, and IV)the five-layer nonlinear waveguides having symmetric or asymmetric structures. Similarly, our method can be also applied to the analysis of nonlinear waveguide systems with self-defocusing nonlinear thin films.

REFERENCES

1. J.-S. Jeong, S. H. Song, E.-H. Lee, ETRI Journal, vol. 18, pp. 75-86, 1996.
2. J.-S. Jeong, S. H. Song, and E.-H. Lee, *Nonlinear Optics: Materials, Fundamentals, and Applications*, Hawaii, Vol. 11 of 1996 Technical Digest Series, July 8-12, 1996, pp. 67-69.

Table I. Nonlinear dispersion equations of the various nonlinear waveguides.

Case	Waveguide Structures	Nonlinear Dispersion Equations
I		$\frac{\mathrm{sn}(u_1)\,\mathrm{dn}(u_1)}{cn(u_1)} = \frac{q_2}{q_1}$
II		$\frac{\mathrm{sn}(u_1)\,\mathrm{dn}(u_1)\,\mathrm{cn}(u_2)}{\mathrm{sn}(u_2)\,\mathrm{dn}(u_2)\,\mathrm{cn}(u_1)} = \frac{q_2}{q_1}$
III		$\tan\theta = \frac{\gamma_f[q_1 \tanh(u_1) - q_2 \tanh(u_2)]}{(-1)^h \gamma_f^2 + q_1 q_2 \tanh(u_1)\ \tanh(u_2)}$
IV		$\tan\theta = \frac{\gamma_f[q_1\mathrm{sn}(u_1)\,\mathrm{dn}(u_1)\,\mathrm{cn}(u_2) - q_2\mathrm{sn}(u_2)\,\mathrm{dn}(u_2)\,\mathrm{cn}(u_1)]}{(-1)^h \gamma_f^2 \mathrm{cn}(u_1)\,\mathrm{cn}(u_2) + q_1 q_2 \mathrm{sn}(u_1)\,\mathrm{dn}(u_1)\,\mathrm{sn}(u_2)\,\mathrm{dn}(u_2)}$