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Modulational instability of longitudinal nonlinear wave along single wall carbon nanotubes under the effect of higher order inter-atomic interaction potential

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Abstract

In the present study, an attempt is being made to analyze the stability/instability of nonlinear waves in single walled carbon nanotubes (SWCNTs) under the effect of higher order nearest-neighbor interaction potential. We obtain the higher order nonlinear effective potential for SWCNTs by using the Brenner's potential. The rotating wave approximation (RWA) is used to write the dynamics of carbon nanotubes of atoms in the form of discrete nonlinear Schrödinger (DNLS) equation. The linear stability analysis of modulational instability (MI) is used to predict the stability/instability of localized modes and growth rate of the modulation sidebands. We show that the inter-atomic interaction potential drastically changes the conditions for MI gain. We also employ the $(\frac{G'}{G})$- expansion method to solve the DNLS equation and obtain the exact traveling wave solutions with the help of symbolic computation. The traveling wave solutions are expressed by the hyperbolic, the trigonometric and the rational functions. Graphically, we study the effect of interaction potential in SWCNTs.

Keywords: Nanotubes, Localized modes, Anharmonic lattice modes

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