A study on the effect of internal stress on the acoustic non-linearity parameter using non-linear ultrasound spectroscopy.

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Abstract:

Non-linear ultrasound spectroscopy is one of the emerging techniques to calculate the acoustic non-linearity parameter of the material. This work provides the change of acoustic non-linearity parameter with respect to the internal stress in the material. A theoretical framework is developed for the non-linear vibration of the Euler-Bernoulli cantilever beam using material non-linearity caused by higher order elastic constants of the material and defects such as dislocations. The developed equation is solved using the multiple time scales method, and the nonlinear resonant frequency shift was calculated. Acoustic non-linearity parameter is caused due to lattice anharmonicity (β_l) and material dislocation (β_d). Here, the dependence of internal stress on the dislocation part (β_d) is studied extensively. Instead of using internal stress as the external biasing stress, theoretical equations are developed to relate internal stress with dislocation parameters. Finally, the relationship between nonlinear frequency shift to the internal stress and dislocation density in the beam was formulated.