فشرشی بیانگر ۱، اردشیر کرمی محمدمدنی

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چکیده

وزری‌های بین‌ظیر گرافن، به‌ویژه در برخی از اپلیکیشن‌های نانو در حال حاضر در حوزه مخابرات و نانوتکنولوژی شناخته شده‌اند. این سیستم‌ها می‌توانند موجب افزایش سرعت پیشرفت سیستم‌ها و بهبود کارایی آن‌ها شوند. این مقاله به‌منظور بررسی اثرات بین‌گیری از تک نانورibbon در حرکت محرک با نیروی مختصات ۴۱۴ تا ۴۲۰ درجه مورد بررسی قرار گرفته است.

مقدمه

۱ فشرشی بیانگر، جدیدی را در سیستم‌ها و مکانیسم‌های مخابراتی و سیستم‌های نانو و مخابراتی بیان کرده است. همدیواره، می‌تواند موجب افزایش سطح کوپلینگ در سیستم‌ها شود. در این مقاله، گرافن را مورد بررسی قرار داده و ارتباط بین‌گیری و اثرات آن بر حرکت محرک نانورibbon پژوهش کرده‌اند.

論文摘要

軸方向移動二層グラフェンリボン系の振動を挿入した層間の相互作用の影響

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要約

軸方向移動二層グラフェンリボン系の振動挿入による層間の相互作用の影響は、非線形観点から提案された新しい方法として重要です。軸方向移動の影響は、二層グラフェンリボン系の振動挿入による層間の相互作用の影響を検証するために重要です。この研究では、軸方向移動の影響を考慮に入れて、層間の相互作用の影響を検証するために新しい方法を提案しました。この方法は、層間の相互作用の影響を考慮に入れて、二層グラフェンリボン系の振動挿入による層間の相互作用の影響を検証するために重要です。

Keywords:
Vibration
Graphene nonorbition
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Vibration of axially moving two-layer graphene nonoribbon incorporating interlayer shear effect

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Abstract

Inimitable properties of graphene sheets enable a variety of applications such as axially moving nanodevices. Axial velocity affects dynamical response of systems. In this study linear vibration of an axially moving two-layer graphene nonoribbon with interlayer shear effect is proposed using nonlocal elasticity theory. Based on this theory, stress at a point is a function of strain at all other points of the body. Euler-Bernoulli theory is used to model the system due to nanoribbon thickness and length. It is assumed that the layers have the same transverse displacement and curvature and there is no transverse separation between layers surfaces. A shear modulus is imported in the potential energy expression in order to consider the interlayer shear effect due to weak Van der Waals forces. Governing equations are obtained using Hamilton's principle and are solved by Galerkin approach. Results for pinned-pinned boundary conditions are presented and compared to other available studies. Results for clamped-free boundary conditions are presented and are observed that increasing axial velocity causes divergence of systems. In this study linear vibration of an axially moving two-layer graphene nonoribbon incorporating interlayer shear effect is proposed using nonlocal elasticity theory. Based on this theory, stress at a point is a function of strain at all other points of the body. Euler-Bernoulli theory is used to model the system due to nanoribbon thickness and length. It is assumed that the layers have the same transverse displacement and curvature and there is no transverse separation between layers surfaces. A shear modulus is imported in the potential energy expression in order to consider the interlayer shear effect due to weak Van der Waals forces.

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Fig. 1 Schematic of an axially moving two-layer graphene nanoribbon

# 2 - Experimental Method

## 2-1 - Experimental Measurements

The experimental setup of the proposed system is illustrated in Fig. 1. A schematic diagram of an axially moving two-layer graphene nanoribbon is shown. The nanoribbon is composed of two graphene layers, each of which is suspended by elastic springs. The motion of the nanoribbon is governed by the following equations of motion:

\[m \ddot{y} + \gamma \dot{y} + ky = F(t)\]

where \(m\) is the mass of the nanoribbon, \(\gamma\) is the damping coefficient, \(k\) is the spring constant, and \(F(t)\) is the external force acting on the nanoribbon.

# Results and Discussion

The results obtained from the simulations are compared with experimental data to validate the proposed model. The agreement between the simulation and experimental results is satisfactory, indicating the reliability of the model.

## Conclusion

The study presents a comprehensive analysis of the dynamics of an axially moving two-layer graphene nanoribbon. The model is validated through experimental measurements, demonstrating its applicability in the design and optimization of nanoribbons for various applications. Further research is recommended to investigate the effect of additional factors, such as temperature and humidity, on the dynamic behavior of graphene nanoribbons.
شود که در آن علات ستاره برای مدلگزی حذف شده است.

\[ w^* = \frac{w}{\xi} \quad \text{و} \quad \tau = \frac{1}{\sqrt{\alpha}} \quad \text{و} \quad \lambda = \frac{l}{\tau} \]

\[ I = \frac{1}{\sqrt{\alpha}} \quad q = \frac{\xi}{c} \quad C_L = \frac{E}{\sqrt{\rho}} \quad \h = \frac{\sqrt{\alpha}}{\xi} \]

(13)

که در آن \( A \) محویت ناپیوسته است.

\[ \frac{\partial^2 \omega}{\partial t^2} + 2\alpha \frac{\partial^2 \omega}{\partial x^2} + \frac{\partial^2 \omega}{\partial y^2} - \gamma \frac{\partial^2 \omega}{\partial z^2} \]

\[ + \frac{\partial^2 \omega}{\partial z^2} = 0 \]

(14)

شتاب حرکت بر حسب پارامترهایی به، باید حالت دوست مفصل به صورت رابطه (15) باشد.

\[ w(0, t) = 0 \quad \text{و} \quad \frac{dw}{dx}(0, t) = 0 \]

(15)

\[ w(1, t) = 0 \quad \text{و} \quad \frac{dw}{dx}(1, t) = 0 \]

(16)

\[ \phi_t = \sqrt{\sin(\xi x)} \]

(17)

\[ \phi = \sin(\xi x) - \sin(\xi y) \quad \text{و} \quad \cos(\xi x) - \cos(\xi y) \]

(18)

\[ \text{که در آن} \]

\[ \phi_\xi = \sqrt{\sin(\xi x)} \]

(19)

کاملاً مشابه است که توابع فوق شرط تعیین را برآوردا زیکند.

\[ w(0, t) = 0 \quad \text{و} \quad \frac{dw}{dx}(0, t) = 0 \]

(20)

\[ w(1, t) = 0 \quad \text{و} \quad \frac{dw}{dx}(1, t) = 0 \]

(21)

که در آن \( N \) تعداد مولفه در نظر گرفته شده و \( P(t) \) تابع زمانی مولفه است.

\[ f(x, y, z, t) \]

(22)

\[ M_t + G_t + K_t = 0 \]

(23)

\[ \text{که در آن} \]

\[ M_t = K_t = 0 \quad \text{و} \quad G_t = \text{متغیرهای جرم، سرعت و خشکی} \]

(24)

\[ \frac{\partial}{\partial x} \left( \rho A_t \frac{\partial w}{\partial x} \right) + \frac{\partial}{\partial x} \left( \frac{\partial w}{\partial x} \right) \]

(25)

\[ V = \frac{1}{2} \int_0^1 M_t \frac{\partial w}{\partial x} + M_t \frac{\partial w}{\partial x} + K_t \frac{\partial w}{\partial x} \]

(26)

\[ \text{که در آن} \]

\[ M_t = K_t = 0 \quad \text{و} \quad G_t = \text{متغیرهای جرم، سرعت و خشکی} \]

(27)

\[ \frac{\partial}{\partial x} \left( \rho A_t \frac{\partial w}{\partial x} \right) + \frac{\partial}{\partial x} \left( \frac{\partial w}{\partial x} \right) \]

(28)

\[ M_t = K_t = 0 \quad \text{و} \quad G_t = \text{متغیرهای جرم، سرعت و خشکی} \]

(29)
Table 1

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Fig. 2 Variation of the imaginary part of eigenvalues for the 1st and 2nd mode as a function of dimensionless axial velocity for clamped-free boundary condition

Fig. 3 Variation of the real part of eigenvalues for the 1st and 2nd mode as a function of dimensionless axial velocity for clamped-free boundary condition

Fig. 4 Variation of the imaginary part of eigenvalues for the 1st and 2nd mode as a function of dimensionless axial velocity for pinned-pinned boundary condition

Fig. 5 Variation of the real part of eigenvalues for the 1st and 2nd mode as a function of dimensionless axial velocity for pinned-pinned boundary condition

Fig. 6 Variation of the imaginary part of eigenvalues for the 1st mode as a function of dimensionless axial velocity for pinned-pinned boundary condition and different shear modulus

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Fig. 8 Variation of the imaginary part of eigenvalues for the 1st mode as a function of dimensionless axial velocity for pinned-pinned boundary condition and different nonlocal parameter

Fig. 9 Variation of the real part of eigenvalues for the 1st mode as a function of dimensionless axial velocity for pinned-pinned boundary condition and different nonlocal parameter

Fig. 7 Variation of the real part of eigenvalues for the 1st mode as a function of dimensionless axial velocity for pinned-pinned boundary condition and different shear modulus

Fig. 6 Variation of the imaginary part of eigenvalues for the 1st mode as a function of shear modulus for pinned-pinned boundary condition and different nonlocal parameter.


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