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The success of the Russian-Taiwanese Symposium “Physics and Mechanics of New Materials and Their Applications”, PMNM-2012 (Russia, 2012), 2013 International Symposium “Physics and Mechanics of New Materials and Underwater Applications”, PHENMA-2013 (Taiwan, 2013), 2014 International Symposium “Physics and Mechanics of New Materials and Underwater Applications”, PHENMA-2014 (Thailand, 2014), 2015 International Conference “Physics and Mechanics of New Materials and Their Applications”, PHENMA-2015 (Russia, 2015), 2016 International Conference “Physics and Mechanics of New Materials and Their Applications”, PHENMA-2016 (Indonesia, 2016), 2017 International Conference “Physics and Mechanics of New Materials and Their Applications”, PHENMA-2017 (India, 2017), 2018 International Conference “Physics and Mechanics of New Materials and Their Applications”, PHENMA-2018 (South Korea, 2018) and 2019 International Conference “Physics and Mechanics of New Materials and Their Applications”, PHENMA-2019 (Vietnam, 2019) predefined objectives and scientific directions of the new conference PHENMA-2020, conducted by the Kyushu Institute of Technology (Japan). Due to COVID-19 pandemic, this conference has been postponed from 2–5 October, 2020 to 26–29 March, 2021.

The following PHENMA abstracts cover five scientific directions: (i) processing techniques of new materials, (ii) physics of new materials, (iii) mechanics of new materials, (iv) applications of new materials, and (v) industry and management. These are present by scientists from 17 countries, demonstrating strong scientific collaboration, formed for last years.

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the deterioration of their properties in the framework of Structural Health Monitoring (SHM) technologies. The models are based on the explicit GWs representation in terms of the inverse Fourier transform path integrals of the waveguide's Green matrix, followed by the GWs extraction using the residue technique. The experimental and numerical results obtained for the phantoms under consideration are analyzed and discussed.

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Influences of the Three-Body Interaction and the Deformation of Electron Shells of Atoms on Phonons Energy of Compressed Rare-Gas Crystals

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The most convenient objects for the study of a number of fundamental problems of solid-state physics are rare-gas crystals (Ne, Ar, Kr, and Xe), since they comprise a relatively simple system: they consist of atoms with closed electron shells and contain one atom in the unit cell. In this work, the dynamic matrix is constructed based on the nonempirical version of the quantum-mechanical model of deformed and polarized atoms (Tolpygo model) with allowance for both types of the three-body interactions (due to overlap of electron shells and their deformation). *Ab initio* calculations phonon frequencies are performed at two and ten mean-value points of the Chadi-Kohen method and the influence of all three-body forces on them for compressed crystals of the Ne – Xe series. As previously, the contribution from three-body forces due to the electron shell overlap was small against the background of the pair interaction even at high pressure and most pronounced for Xe, while the effects of electron shell deformations within the pair and three-body approximations differ for different mean-value points. Contribution from the electron shell deformation (for example, for Ne) is varied from 0% to 0.39% at compression $u = p = 0$ and from 0.35% to 55.9% at $u = 0.76$. The average contribution value increases with an increase in pressure from 0.15% to 17.2%. The calculation of $\hbar\omega_\lambda(X)$ performed by us for Ar with a pure pair potential, with neglect of the deformation of the electron shells gives a discrepancy with the experiment of 2.6% for $\hbar\omega_L(X)$ and 8% for $\hbar\omega_T(X)$. The discrepancy with the experiment of our calculations $\hbar\omega_\lambda(X)$ of in the model with neglect of the deformation of the electron shells but with allowance for the three-body interaction due to the overlap of the electron shells is 3.7% for $\hbar\omega_L(X)$ and 6.4% for $\hbar\omega_T(X)$. The allowance for the three-body interaction and the deformation of the electron shells in the pair and three-body approximations reduces this discrepancy for $\hbar\omega_L(X)$ to 1.5% and for $\hbar\omega_T(X)$ to 5.9%, which is close to the experimental error of 5%. The absence of a qualitative experiment makes it very problematic to test the theory by adequate description of phonon frequencies at the boundary of the Brillouin zone, although the short-wave phonons region is most sensitive to details of the theory even at zero pressure.

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Establishing Conditions for the Manifestation of the Piezoelectric Response of Carbon Nanotubes

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Recent studies have shown that carbon nanotubes (CNTs) can demonstrate abnormal piezoelectric properties when they form a deformation which dislocate the atomic lattice symmetry [1 – 3]. Such a deformation can be formed during the CNTs growth process or under the influence of an external local pressure, for example, using a probe of an atomic force microscope (AFM) [1 – 3]. Thus, it can be assumed that the value of the piezoelectric response will depend on the CNTs growth parameters and on the magnitude of the CNTs deformation resulting from external influence. The aim of this work is to identify the conditions for the appearance of the piezoelectric response of carbon nanotubes. To determine the conditions for the CNTs piezoelectric response appearance, the influence of the diameter, height, and growth temperature of CNTs was studied. Arrays of aligned carbon nanotubes grown by plasma enhanced chemical vapor deposition (PECVD) were used as the samples. Experimental studies were carried out by AFM force spectroscopy with the detection of piezoelectric current using a built-in microscope oscilloscope. An analysis of the dependence of the piezoelectric current on the diameter of the CNTs showed that with an increase in the diameter of the nanotubes from 35 to 65 nm, a decrease in the current from 22.6 to 17.3 nA is observed. This can be due to an increase in the bending stiffness of CNTs with an increase in diameter and, as a result, to a decrease in the magnitude of deformation of CNTs at a given load. An analysis of the dependence of the piezoelectric current on the height of nanotubes showed that with an increase in the height from 6 to 12 μm, the current decreases from 19 to 5 nA. Studies of the carbon nanotubes growth temperature influence on their piezoelectric response have shown that the magnitude of the piezoelectric response nonlinearly decreased from 22.5 to 15 nA with increasing growth temperature from 615 to 690 °C. This may be due to a gradual increase in the disorientation of nanotubes and a decrease in structural defects with increasing growth temperature. Thus, in this work, the conditions for the appearance of the carbon nanotubes piezoelectric response were shown. It is shown that the value of the CNTs piezoelectric response depends both on the magnitude of the deformation determined by the geometrical parameters of the CNTs and the magnitude of the external pressure, as well as on the structural characteristics of CNTs determined by growth temperature. However, further research is required to establish the effect of growth parameters on