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**Anisotropy of the mechanical properties of nanoscale materials with a cubic crystal lattice**

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A material having a cubic crystal lattice is characterized by isotropic mechanical properties along the x, y, z axes. In the case of a transition from a bulk material to a nanoplate (having nanoscale along the z axis), anisotropy appears in the mechanical characteristics in the direction of the thickness of the nanoplate and in the directions perpendicular to it. The degree of influence of external surfaces on the mechanical properties of the sample depends on the size of the plate thickness. The energy of the electron-ion system per unit cell, averaged over the thickness of the nanoplate, is determined by the relation [1]:

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where *U*0 is the energy of the electron-ion system of one unit cell, *k=a*/6 (*a* is the cell parameter), *d* is the plate thickness. The mechanical characteristics of the bulk material *Y*0 are determined through the energies of the electron-ion system: *Y*0 = f (*U*0). The same characteristics (along the z axis) for a nanoplate are determined from the relation

,

where *Y*0 is any determined characteristic along the z axis. The same characteristics in the x, y direction of an object having an infinite extent will be close to *Y*0. To take into account the influence of the dimensional factor on the physical characteristics along the x, y axes, it is proposed to determine *Y*x,y as the geometric mean of *Y*0 and *Y*d :

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In the table, the calculated values of Young's modulus for bulk material *E*0 and nanoplates *Ed*, *Ex,y*. are presented.

Tab. The calculated values of the cubic lattice parameter *a* (nm) of Young's modulus *E* (GPa) for the nanoplate along the *x, y, z* axes (thickness parallel to the *z* axis)

|  |  |  |  |
| --- | --- | --- | --- |
|  |  | *d=2 nm* | *d=5 nm* |
| *a* | *E*0 | *Ed* | *Ex,y* | *Ed* | *Ex,y* |
| NiFeCoCrMn | 0,3602 | 203,5 | 197,39 | 200,446 | 201,056 | 202,278 |
| Ni | 0,3524 | 201,9 | 195,97 | 198,935 | 199,528 | 200,714 |

For materials with a cubic crystal lattice that do not have any anisotropy of mechanical characteristics along the x, y, z axes, anisotropy manifests itself when passing from a bulk material to a nanoparticle. The degree of anisotropy depends on both the size and shape of the nanoparticle.

1. D. Zakarian, A. Khachatrian, V. Kartuzov.The influence of the size factor on the formation of eutectic //NANO -2019, Lviv Polytechnic National University, 27-30 August.