Back from the solid temperature to kinetic energy of its macro-molecules

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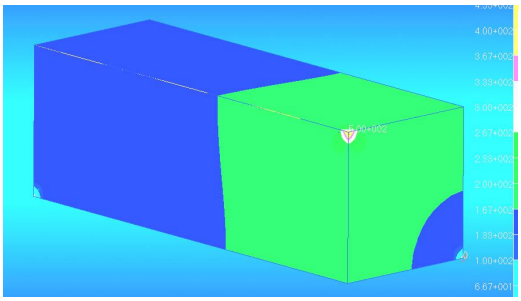
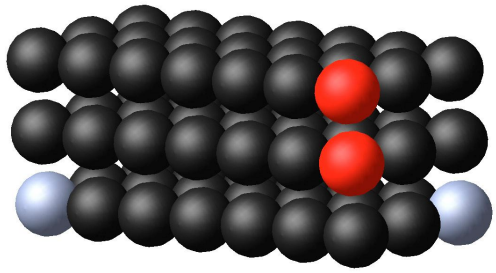
ABSTRACT

The formula $\overline{E} = \frac{3}{2}kT$ establishes the well-known proportionality law between temperature T and averaged kinetic energy of particles, k – is the Boltzmann conversion factor. Long ago, the introduced abstract concepts of temperature and heat conduction gave the possibility to go forward from the original bulky discrete systems to effective continuous models. Now there is the obvious contradiction [1] between the continuous approach and the available discrete-particle models. So, it's time to go back and to use kinetic energy of particles as their essential hotness degree. In this work, it is shown that the continuous heat-conduction problem may be replaced with the transient problem of forced vibration of discrete macro-molecules arranged in the nodes of the solid design lattice.

The considered solid is the aluminium bar. It is loaded by applying three point-temperatures in the bar vertices: the two 0 ºK vertices are in the bottom face, the 500 ºK vertex is in the front edge. The reference continuous steady-state temperature field is in the left figure. The corresponding macro-





molecule model [2] is to the right. The two slate-blue macro-molecules (arranged in the corresponding zero-temperature bottom nodes) are fixed (frozen). The two red macro-molecules in the front edge simulate the applied high-temperature vertex load. These two molecules start to oscillate (in relation to each other) with the given intensity. There is the 3D transient that finally converges to a steady-state kinetic-energy distribution. It turns out, that parameters of the macro-molecule force characteristic may be adjusted so, that the reference MSC.Nastran temperature field and the obtained MSC.Adams macro-molecule kinetic-energy distribution are similar.

REFERENCES

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[2] Sergey V. Arinchev. *Simulation of high-ratio compression of a parallelepipedal duralumin bar using the particle-based method and MSC.Adams software* // CIMNE. Proceedings of the III International Conference on Particle-based methods. – Fundamentals and Applications. University of Stuttgart (Germany), 2013, 18-20 September, Ebook: p. 670-680.