A Globular Protein as a Metamaterial Prototype for Electromagnetic-Acoustic Conversion at Low Temperatures

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The investigation is devoted to give proof to the simple idea, that a globular protein is a molecular machine. This machine effectively converts electromagnetic energy of thermal equilibrium radiation (TER) to energy of acoustic oscillations associated with low-temperature equilibrium fluctuations of protein structure. The laws of thermal equilibrium radiation , the activation process model and photon-to-phonon transformation mechanism in solid state are used to prove this idea. The absorbing ability of a globule is calculated for myoglobin and beta-hemoglobin macromolecules. It is shown, that up to 36 - 37 % of electromagnetic energy of thermal equilibrium radiation is conversed to energy of the phonon bath. Then the bath's energy is used to enable low-temperature equilibrium fluctuations of a globule. Thus, it is proved, that protein macromolecule is an acoustic resonator capable to store energy for structural transformations. So, a globular protein can be used as a metamaterial prototype for electromagnetic-acoustic energy conversion at low temperatures [1].

[1] Stepanov, A. V. *Proc. of SPIE.* **2011**, 8070, 807013-1 – 807013-13.