

Nanochemistry and biotechnology

Temperature-Independent Properties of Biological Nanoscopic Structures

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To explain the temperature-independent desensitization kinetics of biological receptors in nerve cell membranes (Figure 1) as well as the insensitivity of temperature of degradation of period-determining proteins bioluminescence in fibroblastes (Figure 2), a microscopic mechanism of relaxation transitions in the functional nanoscopic structures is proposed. It is obtained that the transitions between the molecular states are accompanied by creation or annihilation of low-frequency phonons in the environment. The lack of temperature dependence in rate constants occurs due to the random thermodynamic fluctuations of positions of energy levels participating in the degradation process. The mechanism is most apparent when accounting for the environment-induced relaxation transitions between the nearly isoergic states within the system.

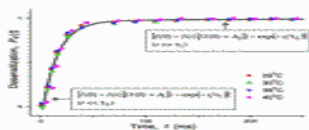


Fig. 1 Two-exponential temperature independent kinetics of the desensitization onset of P2X₃ receptors [1].

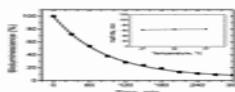


Fig. 2. Single-exponential temperature independent kinetics of the degradation of PER2 protein [2].

From Figures 1 and 2 it follows that the theoretical description (solid lines in figures) proposed is in good agreement with the existing experimental results.

1. V. Khmyz, O. Maximyuk, V. Teslenko, A. Verkhatsky, O. Krishtal, Pflugers Arch.-Eur. J. Physiol. **456**, 339 (2008)
2. Ya. Isojima, M. Nakajima, H. Fujishuma, et al. PNAS USA, 106, 15744 (2009).