

Applications of chemiluminescence to bioenergetic and biochemical studies

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The paper reviews theoretical and experimental investigations concerning generation of electronically excited, light-emitting molecules in chemical reactions i.e. hemiluminescence (CL). Basic parameters of CL - total and partial quantum efficiency, light intensity and spectral distribution of CL - as well as methods of their measurements are presented. A comprehensive discussion on mechanisms of chemical energy transformation into the electronic excitation covers such processes as the electron transfer reaction, concerted cleavage of the dioxetane ring system and radical dismutation. The relevance of CL, particularly of the chemiexcitation step to the energetics and metabolism of biological systems is emphasized. Recent works on the spectral distribution of an ultra-weak CL accompanying a cell division, the so called mitogenetic radiation are shortly reviewed. The microsomal hydroxylation of polycyclic aromatic hydrocarbons, associated with the adventitious biological CL probably plays the key role in the chemical carcinogenesis. The participation of singlet oxygen in certain reactions of great biological interest and chemiluminescent methods of 1O_2 - detection are one of the most actual topics in biochemistry, medicine and environmental sciences. Also last works dealing with the use of CL and bioluminescence as a very sensitive tool for the quantitative assay of biologically important compounds like ATP, NADH, H_2O_2 , some enzymes and substrates are described. Application of a sensitized CL - system, including the dioxetane ring participation in the analysis of aromatic aminoacids by thin layer chromatography, depicts some advantages of chemiluminescent methods in quantitative analysis.