Editorial

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Editorial Note on Bioluminescence

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Bioluminescence is the production and emission of light by a living organism. It is a form of chemiluminescence. Bioluminescence occurs widely in marine vertebrates and invertebrates, in some fungi, microorganisms including some bioluminescent bacteria and terrestrial arthropods such as fireflies. In some species the luciferase requires other cofactors such as calcium or magnesium ions and also the energy-carrying molecule adenosine triphosphate. In evolution, luciferins vary little: one in particular, coelenterazine, is found in 11 different animal phyla, though in some of these, the animals obtain it through their diet.

The uses of bioluminescence by animals include counter-illumination camouflage, mimicry of other animals, for example to lure prey, and signalling to other individuals of the same species, such as to attract mates. In the laboratory, luciferase-based systems which are used in biomedical research and genetic engineering.

Bioluminescence is the capacity of living organisms to emit visible light. Bioluminescence is routinely used to assess the efficacy of sanitation, and several commercial devices are available for this purpose. The detection of specific pathogens is more problematic as methods are required to selectively introduce the bioluminescence genes into the target and then induce expression.

Chemiluminescence which differs from fluorescence or phosphorescence in that the electronic excited state is the product of a chemical reaction rather than of the absorption of a photon. It is the antithesis of a photochemical reaction, in which light is used to drive an endothermic chemical reaction. Here, light is generated from a chemically exothermic reaction. The chemiluminescence induced by an electrochemical stimulus, in this case is called electrochemiluminescence. In chemical kinetics, infrared chemiluminiscence refers to the emission of infrared photons from vibrationally excited product molecules immediately after their formation. The intensities of infrared emission lines from vibrationally excited molecules are used to measure the populations of vibrational states of product molecules.

Chemiluminescence is used for gas analysis and for determining small amounts of impurities or poisons in air. Other compounds can also be determined by this method (ozone, N-oxides, S-compounds). Highly specialised chemiluminescence detectors have been used recently to determine concentrations as well as fluxes of NOx with detection limits as low as 5 ppt. Analysis of inorganic species in liquid phase. Analysis of organic species which are useful with enzymes, where the substrate is not directly involved in the chemiluminescence reaction, but the product is detection and assay of biomolecules in systems such as ELISA and Western blots and DNA sequencing using pyrosequencing.