1,2-Dioxetanes as Chemiluminescent Probes and Labels

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Published in:
EPRINTS-BOOK-TITLE

Publication date:
1981

1,2-DIOXETANES AS CHEMILUMINESCENT PROBES AND LABELS

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There are at the present time relatively few techniques for "on-site" investigations of biological systems. Key existing techniques are for example, fluorescent as well as various radioactive labels. A new and promising method would be to use as probes or labels, compounds capable of emitting - under sharply defined conditions - chemiluminescence. The characteristics of the emitted chemiluminescence should give information concerning the site from which it is emitted. When 1,2-dioxetanes are used one can readily control the emission by regulation of the temperature (1).

We are currently investigating two approaches to the use of 1,2-dioxetanes in this context. We have found in the past that 1,2-dioxetanes containing adamantyl groups have good stability characteristics and we have therefore designed our dioxetanes with this in mind.

One approach is to prepare *probes,* the physical nature of which can be varied by means of the substituents attached to the adamantyl nucleus, the substituents being chosen to make the probe compatible with the local environment in which it must function. We envisage the use of such probes in, for instance, membranes (long fatty chains attached to the adamantyl nucleus). On thermal activation (temperatures slightly above physiological are sufficient) chemiluminescence will occur, and this can be analyzed to provide information about the environment around the 1,2-dioxetane.

Another approach is via *labels,* which by means of chemically reactive substituents can be attached by covalent bonds to a target substituent of a specific target molecule. For

ISBN 0-12-208820-4

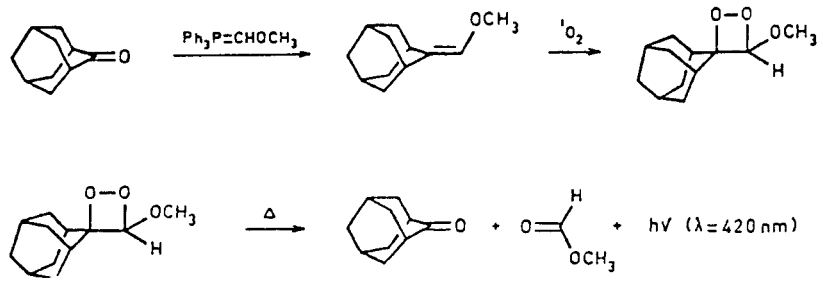

FIGURE I.

instance, thiol groups of a peptide can be specifically labeled. Again only thermal activation is required to cause the label to chemiluminesce.

The two approaches to chemiluminescent probes and labels must be worked out with different types of 1,2-dioxetanes. Probes should chemiluminesce at temperatures between 40-80° and therefore 1,2-dioxetanes of adamantane enol ethers have been developed as outlined in Fig. I (2). Labels should be stable at physiological temperatures and give chemiluminescence at any desired moment. These compounds are prepared from the corresponding functionalized adamantylideneadamantanes by photooxygenation, the general route is outlined in Fig. II (3-5). We will investigate the syntheses and physical characteristics of compounds which can be used as probes and labels, in respectively vesicles and membrane studies (probes) and immonological assays (labels).

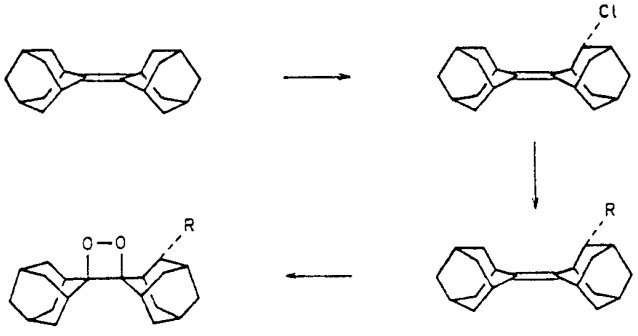

FIGURE II.

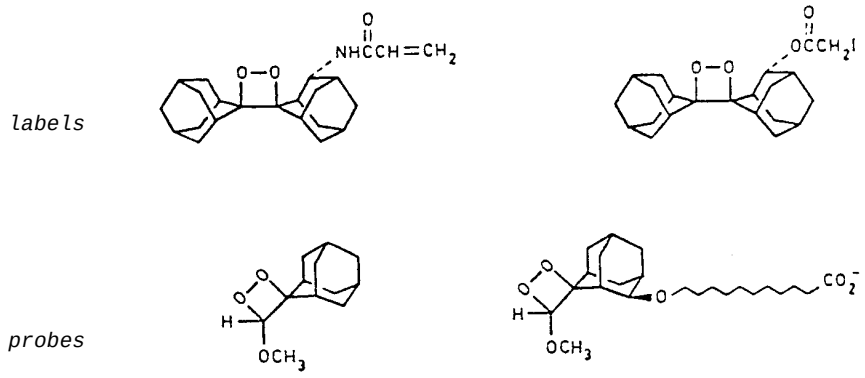

FIGURE III.

Examples of approaches are shown in Fig. III. In this figure there are adequate possibilities for regulating, by means of substituents, the thermal stability of the 1,2-dioxetanes and the desired physical properties of the molecules.

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