The Kinetic Scheme

It is possible to describe the de-excitation of a simple fluorescent molecule A by a first order kinetic scheme.

PROCESS	RATE CONSTANT	DESCRIPTION
1A* → A	kr	radiative emission
1A* → A	kic	internal conversion
1A* → 3A*	kisc	inter-system crossing
1A* → B + C	kd	dissociation
1A* + Q → A	kq	quenching

Scheme 1

The rate of loss of the excited singlet state may thus be given by

$$\frac{-d\left[{}^1A^*\right]}{dt} = \left[{}^1A^*\right]\left\{k_r + k_{ic} + k_{isc} + k_d + k_q[Q]\right\} \quad (1)$$

This equation may be solved to yield an exponential decay law:

$$\left[{}^1A^*\right] = \left[{}^1A_0^*\right]\exp\left(\frac{-t}{\mathrm{t}}\right) \quad (2)$$

where [1A*0] is the initial excited state concentration and the lifetime τ is given by:

$$\tau = \frac{1}{\left\{k_r + k_{ic} + k_{isc} + k_d + k_q[Q]\right\}} \quad (3)$$

If other processes such as energy transfer or excimer formation occur, this kinetic scheme becomes more complex and the decay law may become non-exponential.

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