The chemical specificity of enzyme

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From the Fröhlich's equation of the selective attraction of macromolecules [1] the equation of motion of substrate molecule in dipole field of the enzyme is deduced:

$$\left(\frac{d^2}{dt^2}+\omega_S^2\right) y_S+\beta^2\alpha_E \cos \omega_E t=0 \qquad (1)$$

Where ω_S, ω_E are the frequences of substrate and enzyme respectively, α_E is the amplitude of the dipole field of enzyme, β^2 is the Fröhlich's coupling constant[1]. The unstable solution of Eq.(1) gives the strong selectivity on the frequences of the dipole field of enzyme:

$$\omega_S=\frac{n}{2}\omega_E \qquad (2)$$

Where n takes positive integers or only even positive integers (if the substrate has no permanent dipole).

According to the similarity of Eq. (1) with the equation of the selective isotope-separation[2] by laser, we believe that at least part the specific chemical reaction of enzyme is similar to the selective chemical reaction induced by laser light. Therefore, we propose the man-made biocatalysis experiment by using laser light. The dissociation rate of a substrate molecule can be experessed as following:

$$t^{-1}\approx\mu\omega_E/(3 \text{ or } 4) \qquad (3)$$

Where μ is Floquet exponent depending on the dipole field of enzyme and the properties of substrate.

Recently Popp[3] and others have discovered the stimulated emission from the cell and Biscar[4] has measured the action spectrum of enzyme stimulated by laser. These facts make the prospect of man-made biocatslysis promising. We have also calculated the dissociation rate of the substrate molecule H_2O_2 by dipole field of enzyme (or laser field) of various strength. The results are reasonable.

References

[1] H. Fröhlich: Phys. Lett., 39A, (1972), 153
[2] N. Bloembergen: Opt. Commun., 15, (1975), 416
[3] F. A. Popp: in Electromagnetic Bio-Information Urban & Schwarzenberg (1979).
[4] J. P. Biscar: Bull. Math. Biol. 38, (1976), 29

酶特异性化学反应模型

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从 Fröhlich 描述大分子间特异性相互吸引的方程出发[1]，考虑到酶与底物系统的开放性质，引出了底物分子在酶偶极场作用下的运动方程：

$$\left(\frac{d^2}{dt^2}+\omega_s^2\right)y_s+\beta^2\alpha_E\cos\omega_E t=0 \qquad (1)$$

这里 ω_s 与 ω_E 分别为底物与酶的本征频率，α_E 是酶偶极场强度，β^2 是 Fröhlich 的耦合系数[1]。该方程的非稳态解(Floquet 解)对酶偶极场的频率具有很强的选择性。良好地描述了酶的特异性化学行为：

$$\omega_s=\frac{n}{2}\omega_E \qquad (2)$$

这里 n 取正整数，若底物无固有偶极矩则只取偶整数。由于运动方程(1)与激光选择性激发分子分解的方程类似[2]，我们相信酶特异性化学反应同激光选择性激发化学反应的机制相似，因此我们建议用激光代替酶进行人工生物催化实验。其分解速率关系式约为：

$$t^{-1}\approx\mu\omega_E/(3\text{ 或 }4) \qquad (3)$$

μ 为 Floquet 指数，是底物分子物性与酶偶极场的函数。

由于 Popp[3] 等人最近发现细胞内的受激发射现象以及 Biscar[4] 测量了激光激发的酶活性谱，我们认为用激光进行人工生物催化的前景是乐观的。本文以 H_2O_2 被酶分解为例估算了分解速率与酶偶极场(或激光场强)之间的关系。结果是合理的。