Note 184(3): Amplification of the Torque with Microwave Frequency Irradiation.

From previous work the amplitude of the driving torque is

$$Tq = \frac{e^2}{2m} A^{(0)2} \underline{\sigma} \cdot \underline{k} \quad -(1)$$

$$= \frac{e^2 \mu_0 c}{2m} \left(\frac{I_n}{\omega^2} \right) \underline{\sigma} \cdot \underline{k} \quad -(2)$$

so the angular displacement is:

$$\boxed{\theta = \frac{e^2 \mu_0 c}{2m I} \left(\frac{I_n}{\omega^2} \right) \underline{\sigma} \cdot \underline{k} \left(\frac{\sin \omega t}{\omega_0^2 - \omega^2} \right)} \quad -(3)$$

where μ_0 is the vacuum permeability, m the mass of the molecule, I its moment of inertia. I_n is the power density of the irradiation in watts m^{-2}, ω its angular frequency, ω_0 a natural frequency of the catalyst.

Units Check

$$\mu_0 = J s^2 C^{-2} m^{-1}, \; I = kgm\, m^2,$$

$$I_n = watt\, m^{-2} = J s^{-1} m^{-2}; \; \omega = \omega_0 = s^{-1};$$

$$J = joule = kgm\, m^2 s^{-2}$$

$$\therefore \theta = \frac{C^2 J s^2 C^{-2} m^{-1} m s^{-1} \left(J s^{-1} m^{-2} m^{-2} \right)}{kgm^2 m^2 s^{-2} s^{-2}}$$

$$= \frac{J^2 m^{-2}}{kgm^2 m^2 s^{-4}} = \frac{kgm^2 m^4 s^{-4} m^{-2}}{kgm^2 m^2 s^{-4}} \quad \checkmark$$

The effect is amplified if:

2) a) $I_n \to \infty$;

b) $\omega \to 0$

c) $\omega_0 = \omega$.

This is a torque set up between the spin magnetic dipole moment of an electron in a molecule or ion and the $\underline{B}^{(3)}$ field. This torque is always present in any material.