Heat Power Due to Laser Excitation:

FDTD theory of surface plasmon resonance:

$$\sigma_{scat} = P_{scat}(\omega)/I_{int}(\omega)$$

$$\sigma_{abs} = P_{abs}(\omega)/I_{int}(\omega)$$

$$P_{abs}(\omega) = \sigma_{abs} * I_{int}(\omega) \_\_\_\_\_(1)$$

Absorbtion Cross-Section as per Mie scattering Theory:

$$\sigma_{abs} = 4\pi k r^3((\epsilon_{np} - \epsilon_{mat})/(\epsilon_{np} + 2\epsilon_{mat}))^2 \_\_(2)$$

$$k = 2\pi\sqrt{\epsilon_{np}}$$

sub (2) in (1).

$$P_{abs}(\omega) = 4\pi k r^3((\epsilon_{np} - \epsilon_{mat})/(\epsilon_{np} + 2\epsilon_{mat}))^2 * I_{int}(\omega) \_\_\_\_(3)$$

Temperature Change:

$$Power = Energy/time$$

$$Energy = m * Cp * \Delta T$$

$$Energy = m * Cp * (T_n - T_o)$$

$$Power = m * Cp * (T_n - T_o)/time$$

$$T_n - T_o = Power/(time * m * Cp)$$

$$T_n = T_o + Power/(time * m * Cp)$$

Mass of Nanoparticle:

$$mass = N * N_A * A$$

Fourier law of temperature change

$$\nabla^2 T = (1/\alpha)(\delta T/\delta t)$$

$$\delta T = \alpha * \delta t[\nabla^2 T]$$

$$T_n = T_o + \alpha * \delta t[\nabla^2 T]$$

$$\alpha = k/Cp * \rho$$

Abbreviations

σ_{scat} __Scattering cross section.

σ_{abs} ___Absorbance cross section.

$I_{int}(\omega)$ ____Intensity of Incident radiation.

$P_{abs}(\omega)$ ____Power of absorbed radiation.

r_____Radius of Nanoparticle.

λ____Wavelenght of incident light.

ϵ_{np} _____Permittivity of nanoparticle.

ϵ_{mat} ____Permittivity of medium.

T_n __New Calculated temperature

T_o __Old or Initial Temperature

time_____Simulation time.

m_____Mass of Material.

Cp_____Specific Heat Capacity.

ρ__Density of material.

k_____Thermal Conductivity of material.

δt_____Time step.

$\nabla^2 T$ _____Rot value of temperature change.

N____Number of atoms in Nanoparticle.

A____Atomic mass number.

N_A ___Avagadro's number.