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Field Susceptibility Method (Green's dyadic)

$\vec{p}(\omega)$

$\vec{E}(\vec{r}, \omega) = \underline{S}(\vec{r}, \vec{r}_0, \omega) \cdot \vec{p}(\omega)$

Field susceptibility (or Green's dyadic function or Field Propagator)

Incident field polarizes the cells \Rightarrow a dipole is induced

Polarization Polarizability

$\vec{p}(\vec{r}_k, \omega) = \chi(\vec{r}_k, \omega) \cdot \vec{E}(\vec{r}_k, \omega)$

Each induced dipole creates a field that interacts with each of the other cells

\vec{E}_0

Induced field

$\vec{E}(\vec{r}, \omega) = \underline{S}(\vec{r}, \vec{r}_k, \omega) \cdot \vec{p}(\vec{r}_k, \omega)$

Lippman-Schwinger equation:

$$\vec{E}(\vec{r}, \omega) = \vec{E}_0(\vec{r}, \omega) + a^3 \sum_{\text{all cells}} \underline{S}(\vec{r}, \vec{r}_k, \omega) \cdot \chi(\vec{r}_k, \omega) \cdot \vec{E}(\vec{r}_k, \omega)$$

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Numerical Simulation

\vec{E}_0

$\epsilon_1 = 2.25$

$\epsilon_2 = -34.7 + i8.7$

$\epsilon_3 = 1.0$

Calculated field intensity

G. Colas des Francs et al. (2005)

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Numerical Simulation

\vec{E}_0

$\epsilon = 2.25$

Normalized Intensity

Distance (nm)

Triangular aperture

Circular aperture

G. Colas des Francs et al. (2005)

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Numerical Calculations: Electric and Magnetic Fields at a Triangular Aperture

$|E|$

$|H|$

Aperture side length: 80 nm

Gold thickness : 300 nm

Distance: 20 nm

Software: COMSOL

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