

Raman spectroscopy

Electron Energy Loss Spectroscopy (EELS)

Raman Spectroscopy

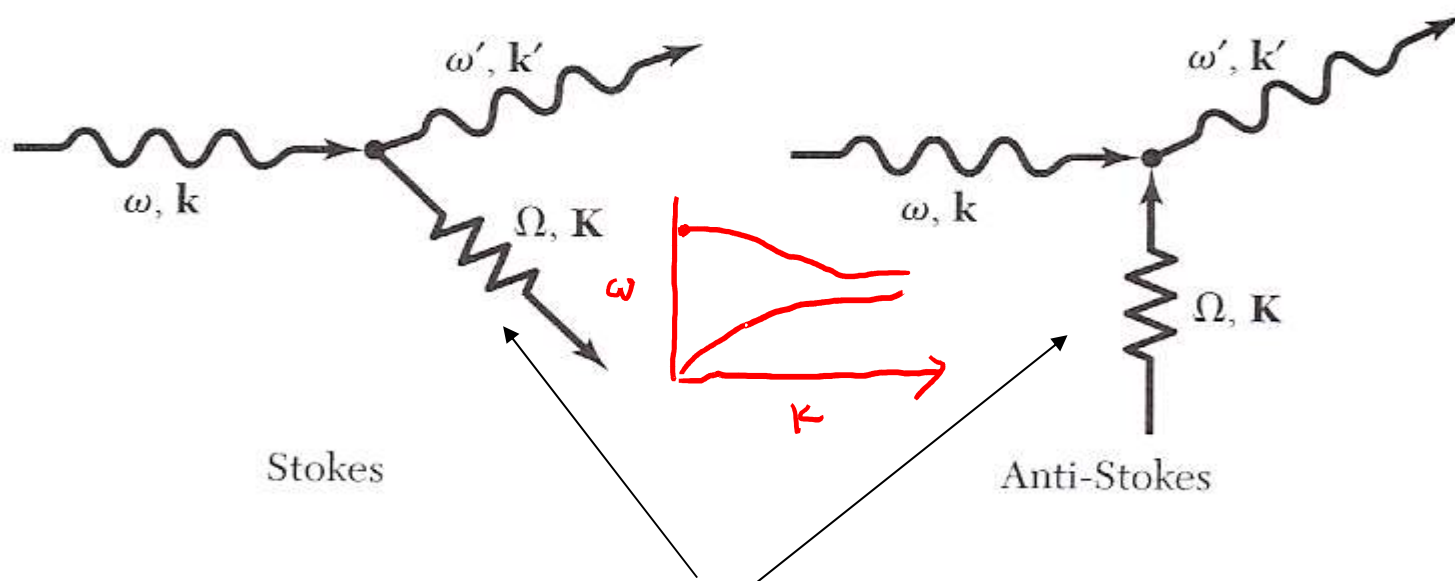


C. V. Raman

Inelastic light scattering

$$\hbar\omega = \hbar\omega' \pm \hbar\Omega$$

$$\hbar\vec{k} = \hbar\vec{k}' \pm \hbar\vec{K} \pm \hbar\vec{G}$$



Phonons, magnons, plasmons, polaritons, ...

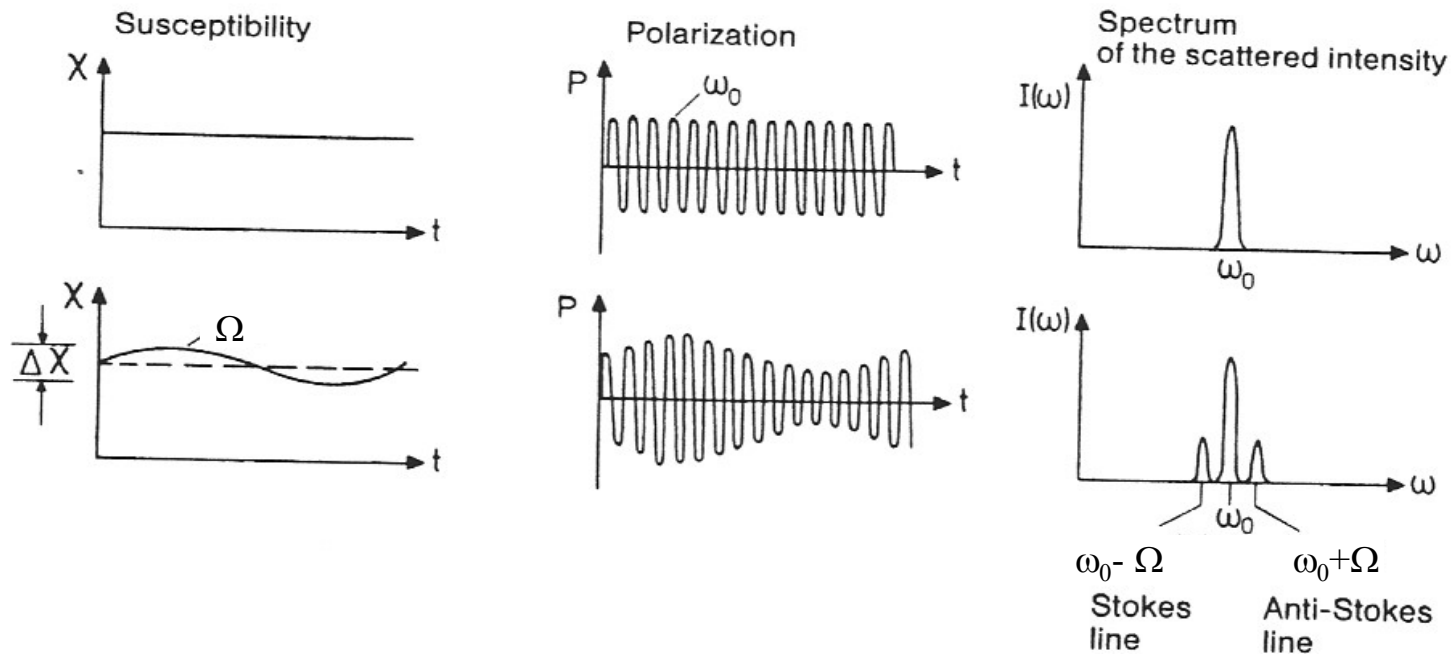
$$\vec{K} \approx 0$$

Raman Spectroscopy

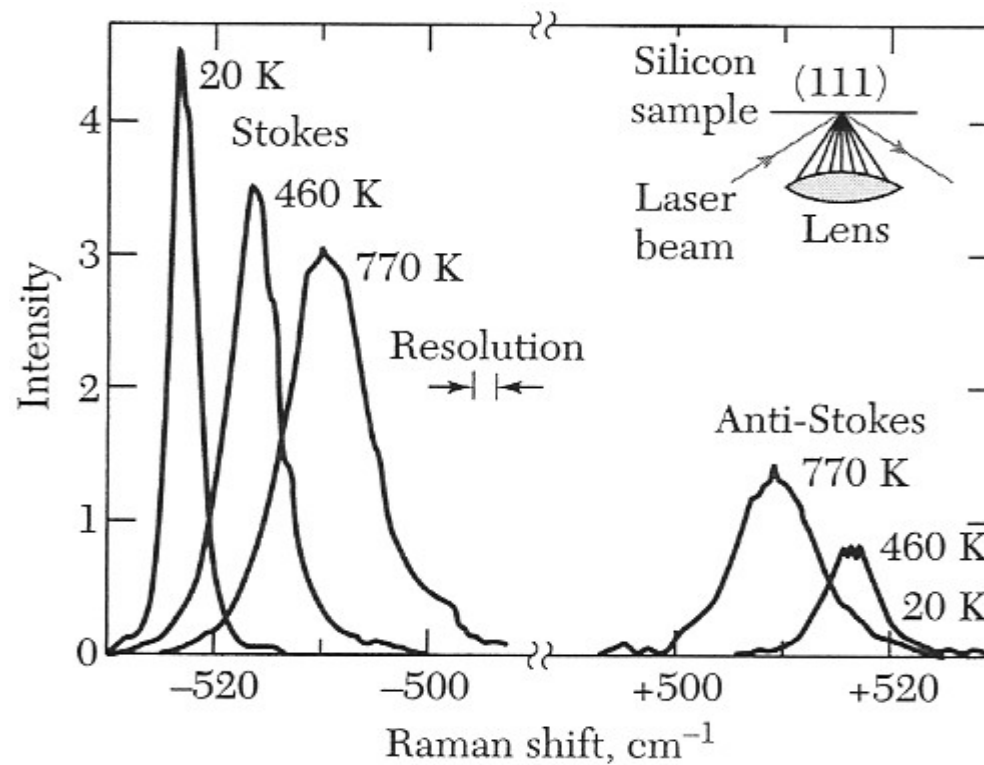
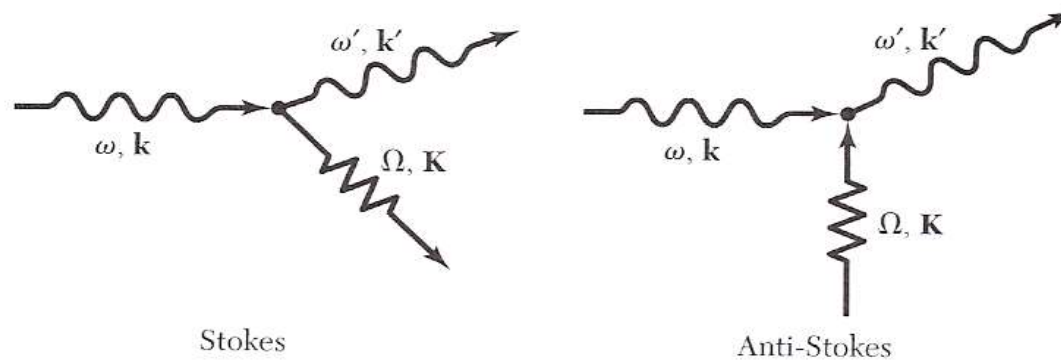
$$\chi = \chi_0 + \frac{\partial \chi}{\partial X} X \cos(\Omega t)$$

$$\vec{P} = \varepsilon_0 \chi \vec{E} \cos(\omega t) + \varepsilon_0 \frac{\partial \chi}{\partial X} X \cos(\Omega t) \vec{E} \cos(\omega t)$$

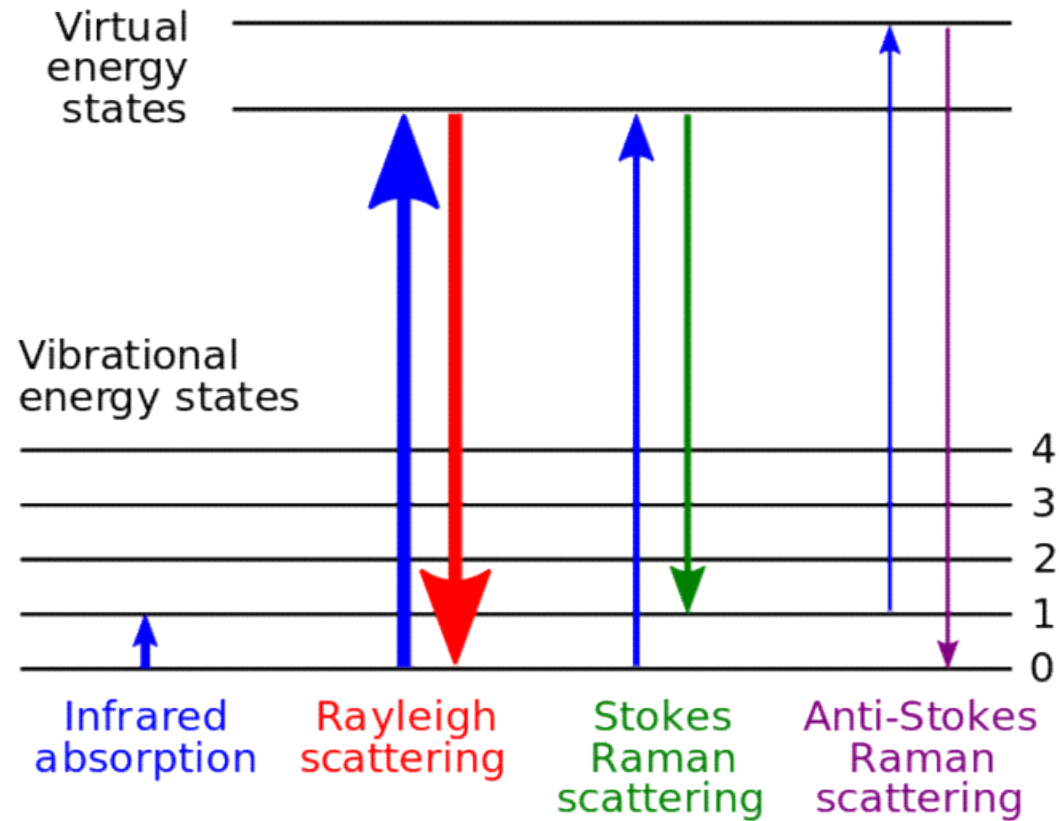
There are components of the polarization that oscillate at $\omega \pm \Omega$.



Raman Spectroscopy

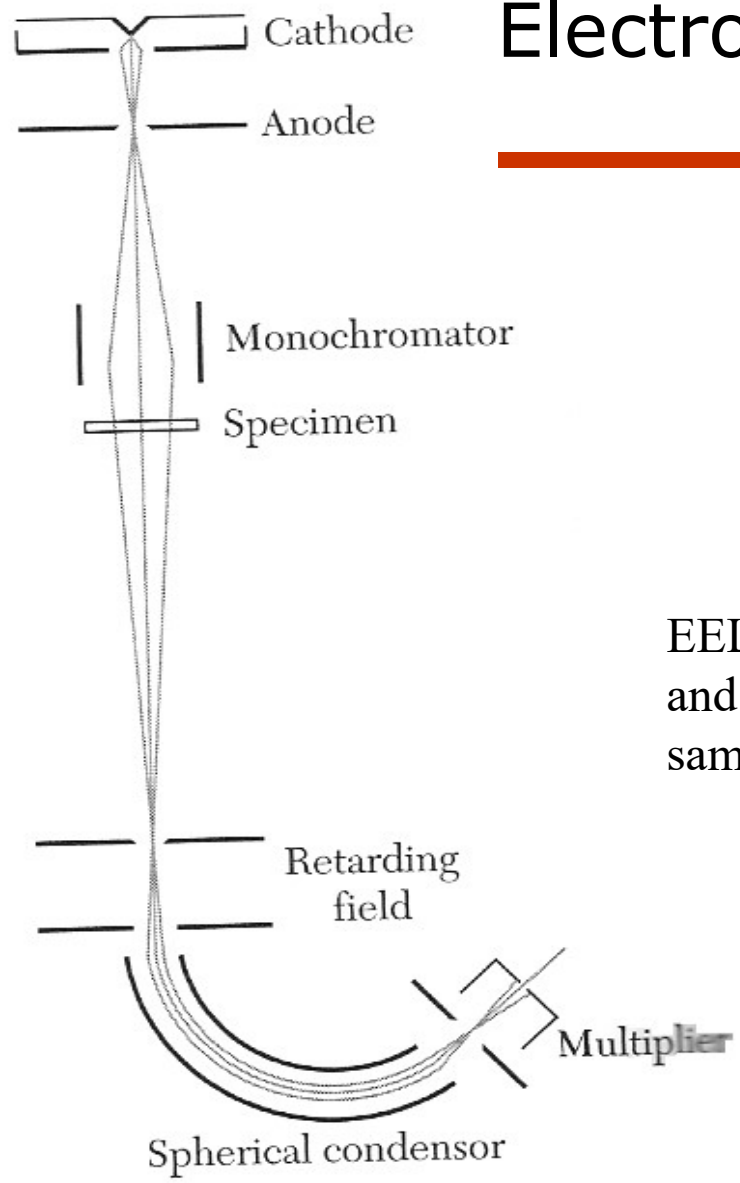


Raman spectroscopy



https://commons.wikimedia.org/wiki/File:Raman_energy_levels.svg

Electron energy loss spectroscopy

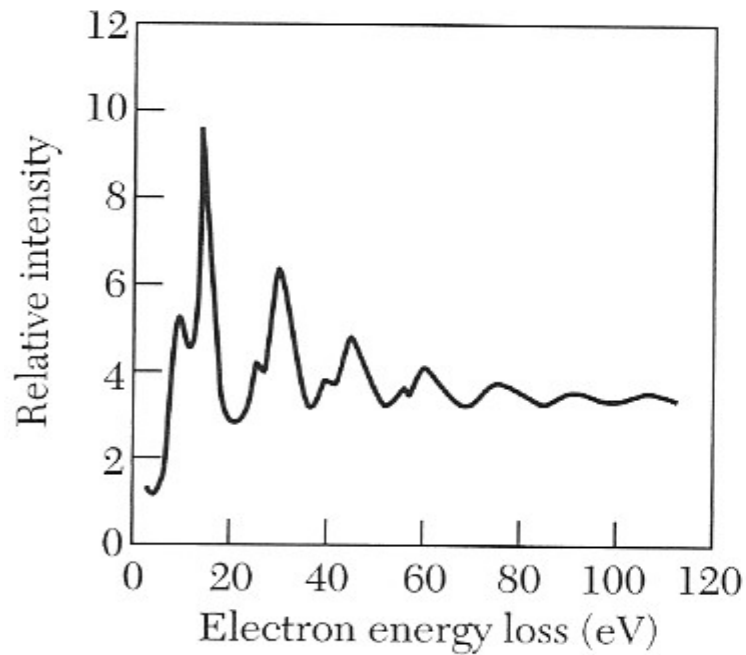


$$\Delta E = n\hbar\omega_p$$

EELS is used to measure phonons, plasmons, and to measure the elemental composition of a sample

Reflection Electron Energy Loss Spectroscopy (REELS)

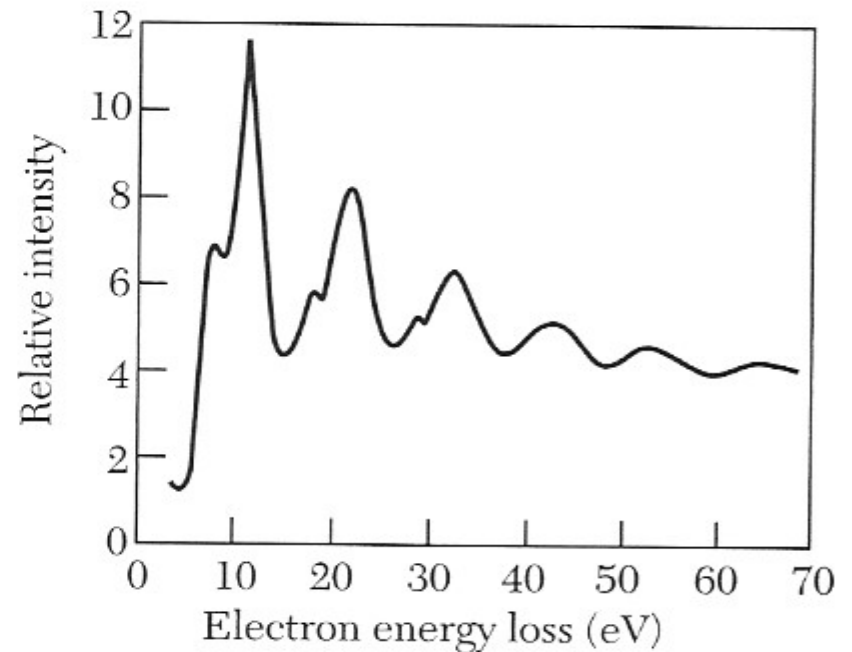
Electron energy loss spectroscopy



Aluminum

Plasmons 15.3 eV

Surface plasmons 10.3 eV



Magnesium

Plasmons 10.6 eV

Surface plasmons 7.1 eV

Electron Energy Loss Spectroscopy (EELS)

