Plasmons:

The free electrons in a metal may be considered an electron plasma. In this case a plasmon is a quasiparticle resulting from the quantization of plasma oscillations of the free electron gas density with respect to the fixed positive ions. Plasmons are Bosons.

The plasmon energy can be estimated as:

$$E_P = \hbar \sqrt{\frac{n \cdot e^2}{m_e \cdot \varepsilon_0}}$$

- n... conduction electron density
- e... elementary charge
- m... electron mass
- ε_0... Permittivity of free space
- $\hbar$... Planck constant

We can define the characteristical plasmon frequency ω_P:

$$\omega_P = \sqrt{\frac{n \cdot e^2}{m_e \cdot \varepsilon_0}} \rightarrow E_P = \hbar \cdot \omega_P$$

The optical properties of metals can be described with plasmons. Light of frequency below the plasmon frequency is reflected, because the electrons in the metal screen the electric field of the light. Light of frequency above the plasma frequency is transmitted, because the electrons cannot respond fast enough to screen it. Most metals and semiconductors are reflective in the visible range because their plasmon frequency is in the ultraviolet. Some metals, such as copper and gold, have electronic interband transitions in the visible range, whereby specific energies (colors) are absorbed. Thus, those metals have a distinct color.