METALLIC BONDING

The Free Electron Model, also known as the Electron Sea Model, has been proposed to provide an explanation for the bonding characteristics observed in metals. The underlying observation is that metals typically exhibit low ionization energy, indicating that valence electrons can be easily liberated from the atoms. This suggests a weak binding of valence electrons to the atomic nucleus. Moreover, in addition to being influenced by their own atomic nuclei, the valence electrons of neighboring atoms can also approach closely to these nuclei.

Within this model, valence electrons enjoy complete freedom of movement within the valence orbitals. Unlike non-metallic elements where valence electrons tend to be localized around individual atoms, in metals, these valence electrons are highly mobile and traverse between different atomic nuclei within the crystal lattice. The Electron Sea Model portrays metals as assemblies of positively charged ions (kernels) immersed in a fluid-like 'sea' of mobile electrons.

The bonding force that holds a metal atom together with a multitude of electrons within its sphere of influence is termed metallic bonding.

This model effectively accounts for various key properties of metals:

(i) **High electrical conductivity:**
The Electron Sea Model attributes the high electrical conductivity of metals to the free movement of electrons within the valence orbitals, allowing for the efficient transmission of electrical charge through the material.

(ii) **High Thermal Conductivity:**
Similarly, the model explains the high thermal conductivity of metals by the unrestricted mobility of electrons, facilitating the rapid transfer of thermal energy through the lattice.

(iii) **Bright Metallic Luster:**
The vibrant metallic luster observed in metals is attributed to the model's depiction of a sea of mobile electrons interacting with incident light, resulting in the characteristic shine associated with metallic surfaces.

(iv) **Malleability:**
The model offers insight into the malleability of metals, explaining that the mobile nature of valence electrons allows layers of atoms to slide past one another without significant resistance, enabling the material to be easily shaped.

(v) **Ductility:**
Ductility, the property of being drawn into thin wires, is rationalized by the model's portrayal of mobile electrons facilitating the rearrangement of atoms without rupture, allowing the material to undergo elongation without breaking.

(vi) **Tensile Strength:**
The Electron Sea Model elucidates the tensile strength of metals by emphasizing the cohesive nature of the metallic bond, which withstands external forces and contributes to the material's ability to resist deformation under tension.

(vii) **Elasticity:**
The model's depiction of a dynamic sea of electrons influencing the metal ions underscores the elasticity of metals, as they can deform under stress and regain their original shape when the stress is removed, showcasing their resilience.

The mobile nature of electrons within the metallic lattice contributes to the remarkable physical and electrical properties exhibited by metals, as elucidated by the Electron Sea Model.