Mechanism : Oxidation occur first at the surface of the metal and the resulting metal oxide scale forms a *barrier*, that tends to restrict further oxidation. For oxidation to continue, either the *metal must diffuse outwards* through the scale to the surface or the *oxygen must diffuse inwards* through the scale to the underlying metal. Both transfers occur (*see* Fig. 2), but the outward diffusion of metal is,

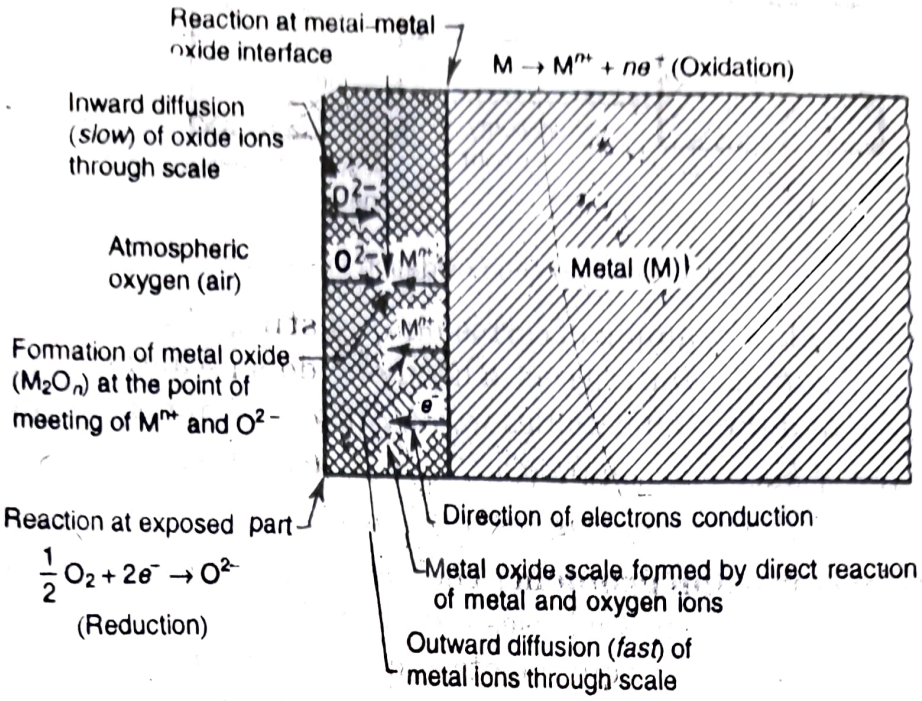

Fig. 2. Oxidation mechanism of metals.

generally, *much more rapid* than the inward diffusion of oxygen, since *the metal ion is appreciably smaller than the oxygen ion* and consequently, of much higher mobility.

Nature of the oxide formed plays an important part in oxidation corrosion process.

$$\text{Metal} + \text{Oxygen} \longrightarrow \text{Metal oxide (corrosion product)}$$

When oxidation starts, a thin layer* of oxide is formed on the metal surface and the nature this film decides the further action. If the film is :

(*i*) **Stable :** A stable layer is fine-grained in structure and can get adhered tightly to the parent metal surface. Hence, such a layer can be of *impervious* nature (*i.e.*, which cuts-off penetration of attacking oxygen to the underlying metal). Such a film behaves as protective coating in nature, thereby shielding the metal surface. *The oxide films on Al Sn, Pb, Cu, Pt, etc., are stable, tightly-adhering and impervious in nature.* Consequently, further oxidation corrosion is prevented.

(*ii*) **Unstable,** *i.e.*, the oxide layer formed, *decomposes* back into the metal and oxygen.

$$\text{Metal oxide} \rightleftharpoons \text{Metal} + \text{Oxygen}$$

Consequently, oxidation corrosion is *not possible* in such a case. *Thus, Ag, Au, and Pt* ***do not*** *undergo oxidation corrosion.*

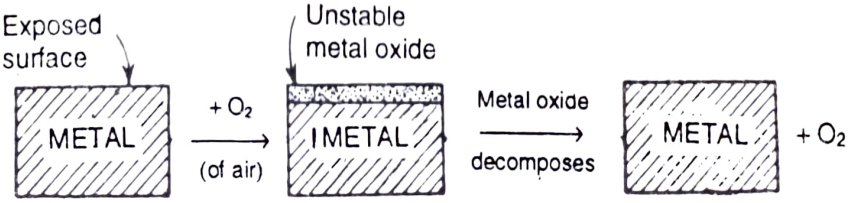

Fig. 3. Unstable oxide layer.

(*iii*) **Volatile,** *i.e.,* the oxide layer *volatilizes* as soon as it is formed, thereby leaving the underlying metal surface *exposed* for further attack. *This causes* ***rapid*** *and continuous corrosion*, leading to excessive corrosion, *e.g.,* molybdenum oxide (MoO_3) is volatile.

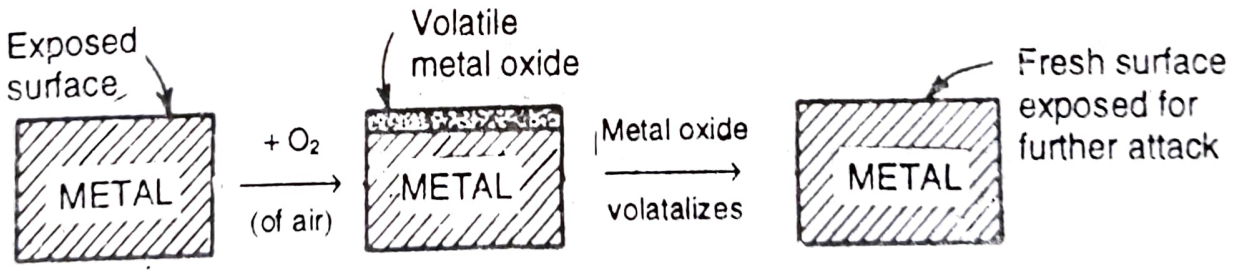

Fig. 4. Volatile oxide layer.

(iv) **Porous**, *i.e.,* having pores or cracks. In such a case, the atmospheric oxygen have *access* to the underlying surface of metal, through the pores or cracks of the layer, thereby the *corrosion continues* ***unobstructed****, till the entire metal is completely converted into its oxide.*

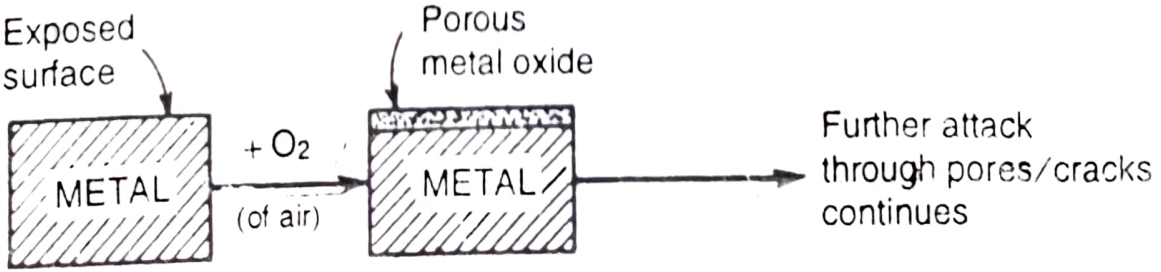

Fig. 5. Porous oxide layer.