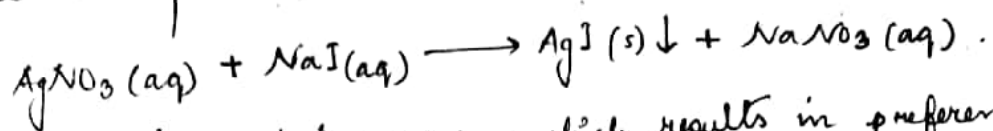
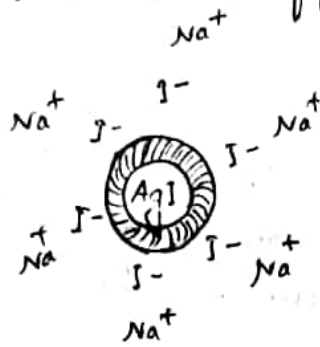


## The electrical double layer:

Let us consider the formation of silver iodide sol from the double decomposition reaction:-



Let, NaI is used in excess which results in preferential adsorption of  $\text{I}^-$  ions giving a negatively charged sol of AgI as shown in fig (a).



The ions preferentially adsorbed on the surface of a particle of a colloidal system are called potential-determining ions.

Fig (a): Negatively charged sol of AgI:

The negatively charged surface of AgI particle attracts the positive ions ( $\text{Na}^+$ ) and repels the negative ions ( $\text{NO}_3^-$ ). As a result the positive  $\text{Na}^+$  ions tend to form a compact layer in the vicinity of the potential-determining  $\text{I}^-$  ion layer. This is called the Stern layer. The ions present in the Stern layer are called the counter ions.

The influence of the surface charge decreases with distance and hence the concentration of  $\text{Na}^+$  ions becomes equal to the concentration of  $\text{NO}_3^-$  ions and a state of electroneutrality prevails. The diffuse layer between the Stern layer and the electrically neutral part of the system is referred to as Gouy-Chapman layer.

The presence of charge gives rise to potential at the surface of the particle. The region in which the charge is appreciable is called electrical double layer. It consists of Stern layer and Gouy-Chapman layer.

## DLVO theory of the stability of lyophobic colloids:

According to this theory, there is a balance between the repulsive interactions between the charges of the electrical double layers on neighbouring particles and the attractive van der Waals interactions between the molecules in the particles. The repulsive potential energy of the double layer on particles, each of radius  $a$ , is given by,

$$V_{rep} = \frac{Aa^2\zeta^2}{R} e^{-s/r}; \quad a \ll \kappa_D, \quad \text{---} \textcircled{1}$$

where  $A$  is a constant,  $\zeta$  is the zeta potential,  $R$  is the separation of the centres,  $s$  is the separation of the surfaces of the two particles and  $\kappa_D$  is the thickness of the electrical double layer.

Eq. ① holds for a thick double layer where  $a \ll \kappa_D$ . For a thin double layer ( $a \gg \kappa_D$ ),

$$V_{rep} = \frac{Aa\zeta^2}{2} \ln(1 + e^{-s/\kappa_D}); \quad a \gg \kappa_D \quad \text{---} \textcircled{11}$$

The potential arising from the attractive interaction is given by,

$$V_{att} = -B/s \quad \text{---} \textcircled{111}$$

where  $B$  is another constant.

Treating the electrical double layer as a simple electrical condenser, the zeta potential  $\zeta$  is given by the expression,

$$\zeta = 4\pi\eta u / \epsilon_r$$

where  $\eta$  and  $\epsilon_r$  are the viscosity and the dielectric constant, respectively, of the dispersion medium and  $u$  is the mobility of the colloidal particles.