Answer on Question #43906 - Chemistry - Inorganic Chemistry

Question:

It seems to me that redox reactions are just another way of talking about ionic reactions. Is there a difference? If there is, what is it?

Answer:

Redox reactions are chemical reactions in which atoms change their oxidation state.
Ionic reactions are reactions involving ions.
In some ionic reactions the oxidation state changes, and in some ionic reactions it does not.
Only those ionic reactions in which the oxidation state changes are redox reactions.
By definition, oxidation state is the hypothetical charge that an atom would have if all bonds to atoms of different elements were 100% ionic.
Examples of ionic reactions which are not redox reactions are given below.

$$\overset{+1}{Ag^+} + \overset{-1}{Cl^-} \rightarrow \overset{+1\ -1}{AgCl}\downarrow$$

Silver ion of charge +1 and chlorine ion of charge -1 form silver chloride where oxidation states of the atoms are equal the charges of the initial ions, i.e. real charges become “hypotetical charges”, but do not change their values.
Another example – neutralization reaction:

$$\overset{+1}{H^+} + \overset{-2\ +1}{OH^-} \rightarrow \overset{+1\ -2}{H_2O}$$

Hydrogen has oxidation state +1 both before (actually it is charge of ion) and after reaction, and oxygen has oxidation state -2 both before and after reaction.

Now, let us consider the ionic reaction which is redox reaction at the same time:

$$2\ KMnO_4 + 10\ FeSO_4 + 8\ H_2SO_4 \rightarrow K_2SO_4 + 2\ MnSO4 + 5\ Fe_2(SO_4)_3 + 8\ H_2O$$

or in the net ionic form

$$2\overset{+7}{MnO_4^-} + 10\ Fe^{2+} + 16\ H^+ \rightarrow 2\ Mn^{2+} + 10\ Fe^{3+} + 8\ H_2O$$

Manganese atom changes its oxydation state from +7 to +2 (i.e. it is reduced) and iron atom changes its oxidation state (actually, charge of ion) from +2 to +3 (i.e. it is oxidized).

In turn, redox reactions may be both ionic and not ionic. The redox reaction given above is an example of ionic redox reaction. But there are a lot of not ionic readox reactions, for example

$$2\overset{0}{Na} + 2\overset{+1}{H_2O} \rightarrow 2Na^+ + OH^- + \overset{0}{H_2}\uparrow$$

Sodium changes its oxidation state from 0 to +1 (i.e. it is oxidized), and hydrogen changes its oxidation state from +1 to 0 (i.e. it is reduced).
Another example – combustion reaction

$$\overset{0}{C} + \overset{0}{O_2} \rightarrow \overset{+4\ -2}{CO_2}$$

Carbon and oxygen atoms change their oxidation states from 0 to +4 and -2, respectively.
Only those redox reactions which involve ions are ionic reactions.