Supramolecular Chemistry-I

Prof. Parimal Kanti Bharadwaj

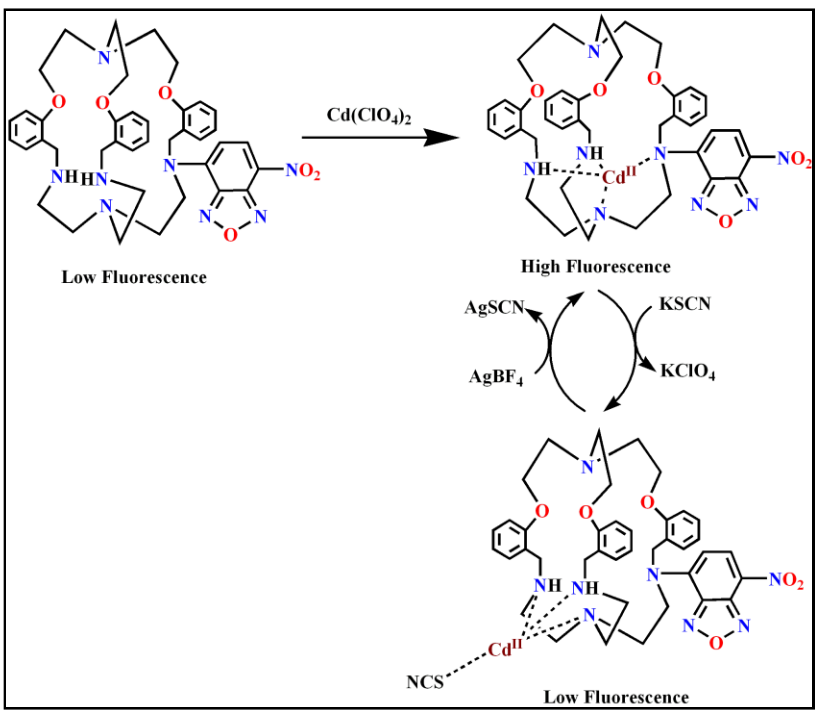
Department of Chemistry

IIT Kanpur

Week - 06

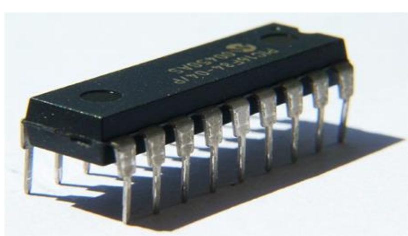
Lecture - 29

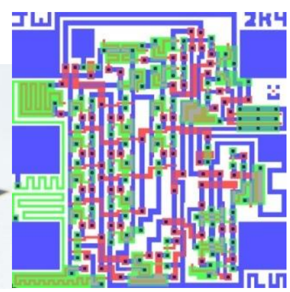
Welcome to the class, I will tell you another phenomenon, it is very important. When in a cryptand we put a metal ion, it goes inside the cavity, why is that? Because of cryptid effect that is extra stability. Suppose we want to put a metal ion outside and then can we bring it inside again? One way to do that would be reducing the donor ability of the atoms that bind the metal ion. So, we put an electron withdrawing compound like, 2, 4 dinitrobenzene group. We empirically found that one 2,4-dinitrobenzene group can influence the binding ability of the cryptand. Another important point: in presence of a non-coordinating anion like ClO_4^- or BF_4^-, the metal can bind from outside. With this knowledge, we have made another way of having reversible fluorescence as follows:



Here, an electron deficient fluorophore has been chosen. The fluorophore is electron withdrawing like 2,4-dinitrobenzene group. When we excite the fluorophore, we see very low emission due to PET being operational. Now cadmium goes inside the cavity here when a perchlorate salt is taken. This blocked the PET from N to the attached fluorophore. So, a high fluorescence emission could be observed upon excitation. Now, if you put potassium thiocyanate which is a coordinating anion, then the metal ion comes out. So, metal ion goes in and comes out depending upon the nature of the anion. This is anion-controlled translocation of a metal ion in a cryptand and we achieve reversibility of emission.

We now discuss another concept. Today's computers are based on silicon semiconductors. Earlier, computers used to be very big. There is a first computer called Newman machine. So, one Newman machine is kept in the University of Chicago. I visited there. In the big hall and some couple of guys have to turn around the wheel. It used to do only basic calculation, but now since with passage of time more and more sophisticated computers have come out. Nowadays, we can have very small computers that can do many jobs. But nowadays we have laptop everywhere. Laptop is just throwing in the you are working in the laptop outside, lots of dust, nothing, but nothing happens. It will not happen. So, with the passage of time, computer has become smaller and smaller and smaller. That is called Moore's law. He predicted that every 2 years, the chip size will be half. Now here I am coming. So, this is called top down approach. So, let us take it. We can go to smaller and smaller and smaller, but can we keep on going to smaller and smaller? That is what I am going to discuss. Suppose you have a computer chip, if you look carefully, you will find something like this.





Now, if we go to smaller and smaller, first we will face problem in fabrication. There will be difficulty in fabrication. Number two point: as we go down, then what will happen? these lines that are part of the circuit, will be very close. Flow of electrons through these circuits will generate tremendous heat. Slowly, we will reach quantum domain and all sorts of problems will appear and simply it will not work.

So, we shall adopt what is known as the bottom-up approach. In this approach, we shall use molecules that can do the job of logic operations. We take this up in our next class.