Dear student,

Welcome to this presentation. I am Dr Dattaprasad Narulkar, assistant professor from Dnyanprassarak Mandal’s college and Research Centre. I'll be presenting you sandwich compounds like ferrocene: reaction from the unit 1 organometallic chemistry. The topic outlined in this module are. Basically, the reactions of the ferrocene. So first we are going to see the reactions of cyclopentadienyl ring of the ferrocene in which we are going to see a different substitution reactions. I mean electrophilic substitution reactions like nitration, carboxylation, Manish condensation, Vilsmeir reaction and then we are going to see the reaction which involves interaction of ring substituents.

Learning outcome

At the end of this module, the student will be able to explain the reactivity of the ferrocene and will be able to predict the products of electrophilic substitution reactions of the ferrocene. Now let's begin with this model. Now reactions of ferrocene are broadly classified as reactions at a cyclopentadienyl ring and reactions which involves interaction with a ring substitution. The molecule that you can see on your slide is a ferrocene molecule which consist of Fe which is sandwiched between the two-cyclopentadienyl ring and S that you can see is substitutes which is attached to the cyclopentadienyl ring. So, reaction can either occur at this ring or they may occur at the substituents.

So, we'll see the reactions which are occurring at a cyclopentadienyl ring. Now basically ferrocene undergoes electrophilic substitution reaction. It is very important to know that Ferrocene does not undergo a nucleophilic substitution reaction. But it undergoes electrophilic substitution reaction just like a free benzene molecule. Now here what happens is electrophile first attack one of the rings of the cyclopentadienyl, which then loses a proton to get a electrophilic product. Now there are different electrophilic substitution reactions which we are going to see one by one.

Now let us see the first reaction that is synthesis of the lithio derivatives of ferrocene. Now the ferrocene reacts with *n*- butyllithium to form a monolithio derivative of a ferrocene if it reacts with one more molecule of lithium, we are going to get *n*- butyllithium derivative of ferrocene, in which lithium will be going to the second ring of the cyclopentadienyl ringn. Now here, lithium is an electrophile. Now lithio derivatives of ferrocene are important intermediate for the synthesis of other. Ferrocynyl derivatives.

Next reaction is carboxylation. As seen in the previous slide we have obtained, a monolithio derivative ferrocene. This then reacts with the carbon dioxide which then further with the acid hydrolysis, gives a carboxylated derivative of the ferrocene. Then next reaction is nitration, which is followed by the reduction. Here again, mono lithio derivative of the ferrocene is going to react with a dinitrogen tetroxide to get a Nitro ferrocene. This can be further reduced using palladium in HCL to get a amino ferrocene.

Next is Friedel crafts reactions. Here we are going to see both the acylation and alkylation reaction. Now here ferrocene is going to react with the acid chloride in presence of the aluminium chloride to get an acyl derivative of the ferrocene. With more molecules in excess of the acid chloride in presence of the aluminium chloride, we are going to get the second ring of the cyclopentadienyl acylated. Now in a similar manner.alkylation reaction also occurs in a same manner. So instead of acid chloride molecules like ethylene is used and again, in presence of the aluminum chloride at 230 atmospheric pressure and 80 degree we are going to get a alkylated product of the ferrocene.

Now presence of this alkyl group on the cyclopentadienyl, increases the electron. density on the ring, thereby, enhances the reactivity in the alkylation reaction and we are going to get a disubstituted product. As seen on the screen, next is Vilsmeirs reaction. In this reaction the ferrocene is going to react with amide in presence of the for phosphorous oxychloride to obtain a aldehydic product.

Then next reaction is mannish condensation. Here, the ferrocene is going to react with a secondary amine in presence of the aldehyde and the base to get an amine product of the ferrocene. In this one of the carbon atom is increased. Now this reaction are not shown by the benzenein OK, but in this the reactivity are more similar to the more reactive aryl, like a thiophene.

Now we are going to see a second class of the reactions of the ferrocene that is interaction with the ring substituents of ferrocene. Earlier we had seen reactions which involves reactions at a cyclopentadienyl ring, but here we are going to see how the substituents, which are attached to the cyclopentadienyl ring are reacting. Now this is one the substituents of the ferrocene. So this derivative in presence of the acetic acid is going to react with the H^+ of the acetic acid to give a stable carbonium ion. This carbonium ion is then further reacts with the acetate to form a corresponding product.

Now these are some of the reactions which are shown by the ferrocene. These are the references or which are used in which you can find a details about the ferrocene and its reactivity. So you can go through this books to understand and explore more chemistry of the ferrocene.

Thank you, very much and happy learning, with DISHTAVO.

Thank you.