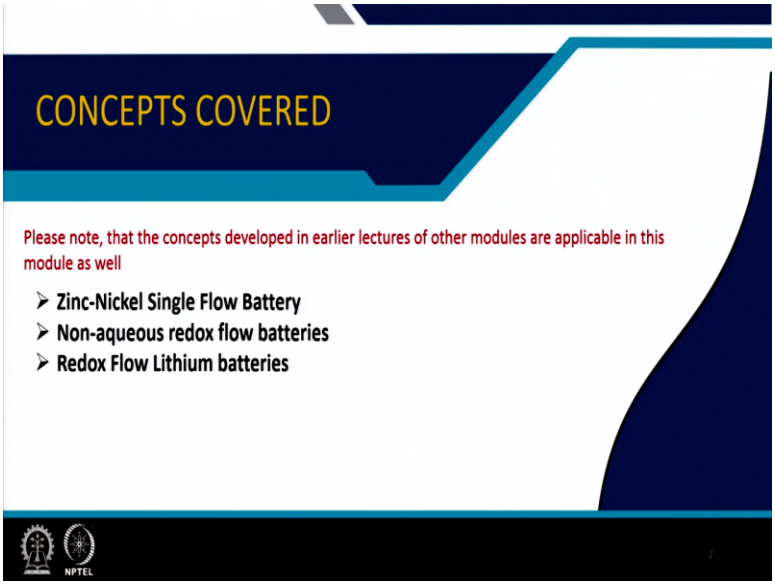
Electrochemical Energy Storage
Prof. Subhasish Basu Majumder
Department of Materials Science Centre
Indian Institute of Technology, Kharagpur

Module - 12
Other types of batteries
Lecture - 60
Other Redox Flow Battery Technologies

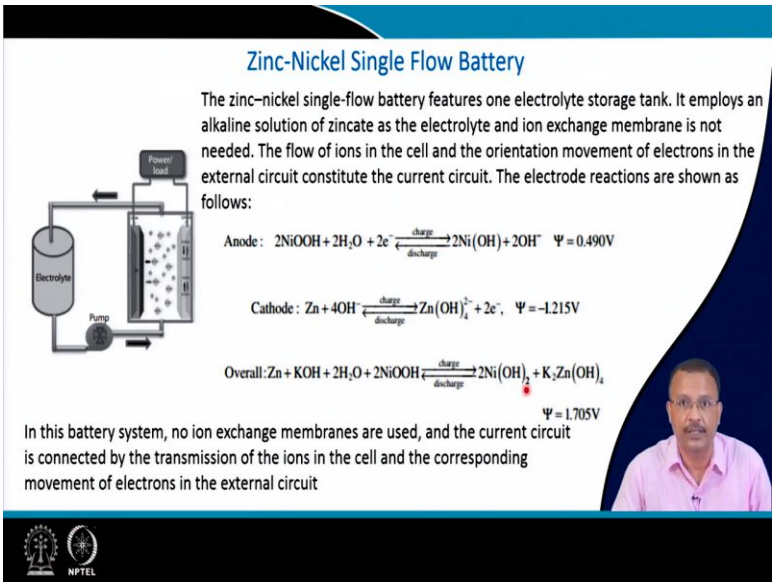
Welcome to my course Electrochemical Energy Storage and this is module number 12 where I am discussing Other Types of Batteries. And this is lecture number 60 where Other Redox Flow Battery Technology I will introduce. In the last lecture I talked about vanadium redox flow battery and in this particular lecture we will talk about the other types of redox flow battery.

(Refer Slide Time: 00:54)



So, one of this kind of chemistry is zinc nickel single flow battery, so that I will introduce. And then second one is the non aqueous redox flow batteries and finally, redox flow lithium batteries. So, these three typical varieties I will introduce very briefly.

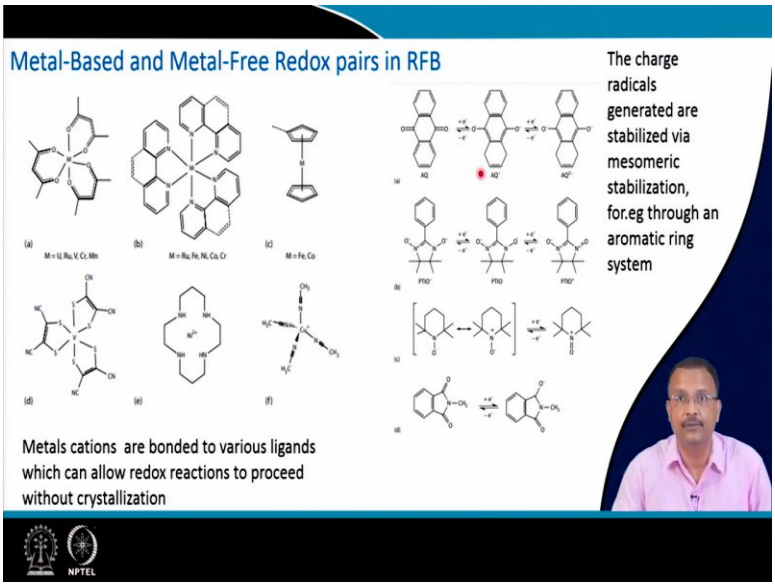
(Refer Slide Time: 01:15)



So, here you can see that in zinc nickel single flow battery it is having feature this is having only one electrolyte storage tank, unlike two separate electrolyte and it does not have any ion exchange membrane. So, no separate ion exchange membrane that is used for this type of battery. So, it is having a separate anode and cathode material and the electrolyte is an alkaline solution of zinc which is zinc OH whole 4 says this zincate is used as an electrolyte and ion exchange membrane is not there.

So, this one is pumped into this cell and in the anode which is nickel oxygen hydroxide oxy hydroxide this reaction takes place during charge which gives a typical potential of 0.490 volt. And in case of the cathode which is basically zinc this reaction takes place and that is the potential that one can get. So, the overall reaction is given by this with a voltage gain is about 0.705 volt. So, this is a quite simple case of the batteries.

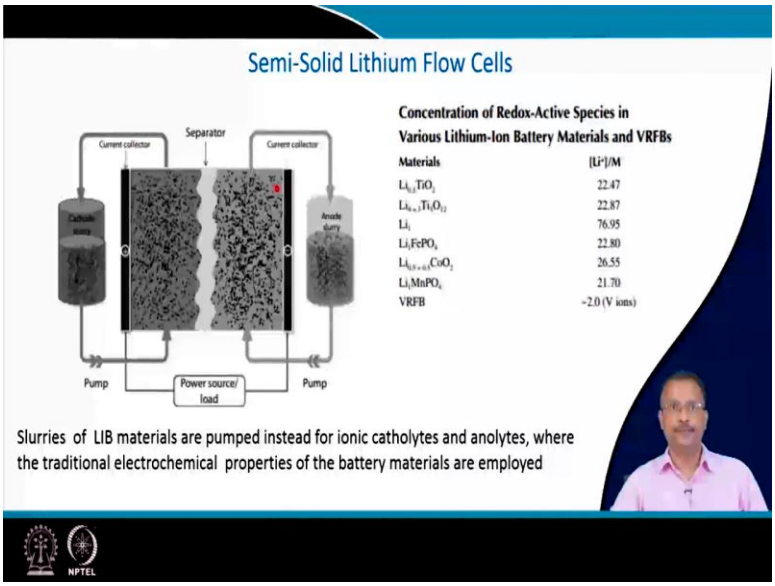
(Refer Slide Time: 02:54)



And in this type of redox flow battery there are various types of configuration of the metal and the ligands that is being used in conjunction. So, metal cations they are basically bonded to various types of ligands and which in fact, allows this redox reaction to produce proceed and there is no apparent crystallization to takes place. And otherwise it could be metal free redox flow as well.

So, this charge radical they are generated and they are stabilized by so called mesomeric stabilization. So, for example, in the way it is shown through an aromatic ring system. So, this both this two types of redox pair is used in redox flow batteries.

(Refer Slide Time: 03:55)

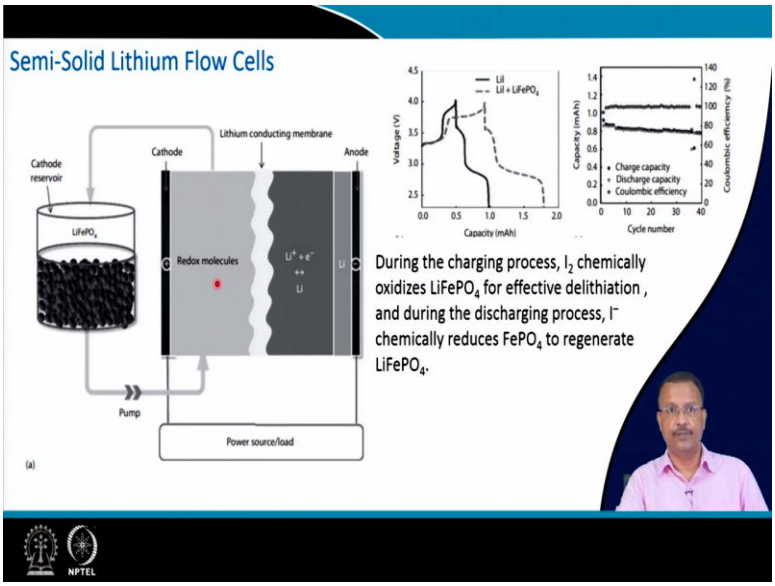


And another example is a semi solid lithium flow cell there the slurries of lithium ion battery materials are used. So, for example, the negative electrode material this lithium titanium oxide that is used in positive lithium iron phosphate, lithium cobalt oxide, lithium manganese phosphate they can be used.

So, the concentration for each of these you can see they are quite high concentration. So, this cathode and anode slurry they are pumped inside this chamber which are separated by this separator. So, this is a traditional electrode they are used for this kind of battery.

One advantage is that the delamination from the current collector during charge and discharge operation in certain chemistry what I already described in the earlier lecture they are no longer there. And in that way this batteries are acceptable and otherwise the chemistry remains same, the same kind of chemistry whatever we described for lithium ion battery that is equally valid for this type of battery as well.

(Refer Slide Time: 05:21)



So, another type is a semi solid lithium flow cell where as you can see that lithium iron phosphate is being used and there is a redox molecule that is used. So, lithium iodide is one of this kind of special additive that is used. Where this iodine they chemically oxidize this lithium iron phosphate. So, effectively this is delithiated, so lithium is taken out.

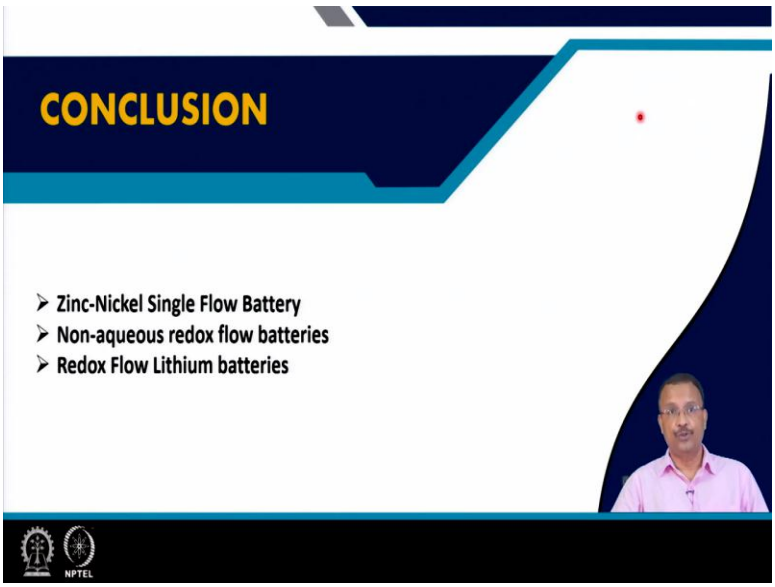
And during discharge process this iodine chemically reduce this iron phosphate the formed iron phosphate to regenerate this lithium iron phosphate. So, that is the charge and discharge reaction that takes place in this type of batteries. So, if you compare the voltage profile for lithium iodide and the voltage profile of lithium iodide mixed with lithium iron phosphate, then you can see that it gives you more charge as compared to pure lithium iodide.

And the capacity reduction after repeated cycling after 40 cycle; they are quite nominal. So, about 80 percent retention is there with a very good coulombic efficiency for this type of battery. So, this is the semi solid lithium flow cell that also has been devised for the rechargeable battery system.

(Refer Slide Time: 07:02)

So, this book is good for redox flow battery system in general I have not covered it at length, I am just introduced the concept that is emerging for this kind of flow battery to maintain the continuity of my whole course lectures. So therefore, module 12 was quite short, in just small lectures I have coupled together just to give you the flavour of this other types of rechargeable cells.

(Refer Slide Time: 07:40)



So, in this particular lecture we talked about zinc nickel single flow battery where only one reservoir is used, unlike two cathode light and anode light reservoirs. Then non

aqueous redox flow batteries we have introduced and redox flow lithium batteries that we have covered.

Thank you for your attention.