[17:05] <Frank> Shall we start or wait to see if anyone else comes?
[17:05] <Doos> exactly
[17:06] <Doos> just start I guess
[17:06] <Doos> I was planning on charge transfer, but you know all that already
[17:07] <Frank> yes but you can recap...or skip to the band theory...never heard of that before
[17:07] <Doos> did you read the article by Nassau I posted last week?
[17:07] <Frank> yes
[17:07] <Doos> any questions on that?
[17:08] <Frank> not prepared no
[17:08] <Doos> oh ok
[17:08] <Frank> but I can think of some if you like
[17:08] <Doos> nah thats ok
[17:08] <Doos> ok charge transfer very quickly then
[17:09] <Frank> I was reading about charge transfer again...Richard hughs explains it well as it pertains to yellow sapphire
[17:09] <Doos> and blue
[17:09] <Frank> yes
[17:09] <Doos> Al203
[17:09] <Doos> that means Al has a valency of +3
[17:10] <Doos> and oxygen -2
[17:10] <Frank> and they combine so they can share them...and become stable?
[17:10] <Doos> if an impurity takes the place of Al, like Fe -2 .. the atom will be instable
[17:10] <Doos> yes
[17:11] <Frank> yes
[17:11] <Doos> you have to look at the relative charge difference
[17:11] <Doos> so Fe-2 is relative to Al
[17:11] <Doos> so Fe-2 is relative to Al+3
[17:12] <Doos> make that Fe+2
[17:12] <Doos> sorry
[17:12] <Frank> sokay I assumed it was a typo
[17:12] <Doos> so Al+3 has one electron less than Fe+2
[17:13] <Doos> does that sound logical?
[17:13] <Frank> yes
[17:13] <Doos> so the relative charge = -1
[17:13] <Frank> yes
[17:13] <Doos> that needs to be compensated somehow
[17:14] <Doos> if there is a Ti+4 around, that would be great
[17:15] <Doos> the Fe+2 will donate an electron to Ti+4
[17:15] <Doos> so it will become Fe+3
[17:15] <Doos> and the Ti4+ will become Ti+4
[17:15] <Doos> and the Ti4+ will become Ti+#
[17:15] <Doos> and the Ti4+ will become Ti+3
[17:16] <Doos> going well today isnt it?
[17:16] <Frank> lol...and either the Fe+3 or the Ti+3 can then replace the Al+3
[17:16] <Doos> yes exactly
[17:16] <Doos> so all is stable again
[17:17] <Doos> that is called "charge compensation"
[17:17] <Doos> one elctron will orbit between Fe+2 and Ti+4 contiously
[17:18] <Frank> what if there is ni Ti+4 around...can the Al+3 and the Fe+2 combine as 2Al+3 3Fe+2 to become stable?
[17:18] <Frank> no ti+4
[17:18] <Doos> I assume so, but Fe+2 doesn't produce colour in corundum
[17:19] <Doos> there are other ways aswell, like creating hole centers

[17:19] <Doos> as in the case of Mg+2
[17:20] <Doos> then an oxygen atom will loose one electron to compensate, but that is not intervalence charge transfer
[17:20] <Frank> they arent joined as a single molecule?
[17:20] <Doos> that will produce yellowish-orange
[17:20] <Doos> yes
[17:21] <Doos> sometimes not .. that will effect the colour thow
[17:22] <Doos> but in the case of Fe+2 + Ti+4 <--> Fe+3 + Ti+3 it is named "charge transfer"
[17:22] <Doos> in iolite the transer is between Fe+2 and Fe+3
[17:22] <Doos> this causes blue in iolite
[17:23] <Frank> so is it the melecular bonding that causes the colour or is it still selective absorbtion of the light passing that molecule?
[17:23] <Doos> slective absorption has to do with direction
[17:23] <Doos> unit cells
[17:24] <Doos> in charge transfer it is the movement of the one electron that causes the colour
[17:24] <Frank> yes but these new molecules have taken up position in the crystal structure so are pretending to be part of a unit cell
[17:25] <Doos> yes
[17:25] <Frank> ok
[17:25] <Doos> I'm sure it will all play some role, but the theory is that the electron absorbs energy and moves
[17:25] <Doos> so produces colour
[17:26] <Frank> can the transformation of Fe+2 to Fe+3 also be classed as charge transfer or is another element required to share that electron
[17:26] <Doos> in iolite it is them two
[17:26] <Frank> Fe+2 and Fe+3
[17:26] <Doos> yes
[17:27] <Doos> holdon potty break
[17:27] <Frank> how do they share?...if one gives to the other there still remains Fe+2 and Fe+3
[17:28] <Frank> or Fe+3 and Fe+2
[17:28] <Frank> brb as well
[17:31] <Doos> because the pure form has Fe+2 in the ideal lattice ... if there is a Fe+3 impurity, it will compensate the charges (or the other way round)
[17:31] <Frank> ok
[17:32] <Doos> if the impurity has the same valency, no problem
[17:32] <Doos> but if it doesn't, it is not happy
[17:33] <Doos> impurities with the same valency are named isovalent
[17:33] <Frank> and heat treatment encourage all this to happen?
[17:33] <Frank> or natural heat of course
[17:33] <Doos> the charge transfer?
[17:33] <Frank> yes
[17:34] <Doos> not sure, I would suspect that heat treatment effects holes more than transfer
[17:34] <Doos> as in under reducing environment .. that might induce a hole
[17:35] <Frank> how can you tell if colour is due to a hole or a transfer?
[17:35] <Doos> most of the time you cant, but if the colour fades .. it's probably due to a hole
[17:35] <Doos> the hole disappears due to heat (at room temp. in some cases)
[17:36] <Doos> so the colour disappears
[17:37] <Doos> did that answer the question?
[17:37] <Frank> yes
[17:37] <Frank> I think so

[17:37] <Doos> heh
[17:38] <Doos> you can remove hole centers by heat
[17:38] <Doos> in some gems 20degrees celsius is enough heat
[17:38] <Frank> yes...even as low as room temp in cases
[17:38] <Doos> that is room temp
[17:38] <Doos> yes
[17:38] <Frank> scary
[17:38] <Doos> well if you know it
[17:38] <Frank> can you induce hole centres ?
[17:39] <Doos> stay away from it .. or make it into a gimic like tenebrescence
[17:39] <Doos> yes by irradiation
[17:39] <Doos> from for instance UV light
[17:39] <Frank> yes...but nice if you can restore the gimmick to it's original colour
[17:39] <Doos> most of the time you can restore it
[17:40] <Doos> aslong as you didn't overheat it
[17:40] <Frank> UV light is good...at least you don't need a reactor
[17:40] <Doos> yes
[17:41] <Doos> hackmanite is an ideal example
[17:41] <Doos> you saw that in Arnhem
[17:41] <Frank> yes
[17:41] <Doos> it was pale when he showed it .. popped it under the UV light and he made the colour
[17:42] <Doos> as simple as that
[17:42] <Frank> I often think of Peters lab...so much to see and do
[17:42] <Doos> the same things happens to other stones .. yet the energy required is larger
[17:42] <Doos> yes nice place
[17:44] <Doos> so all the theory sounds very complicated when you read it, but it really isn't
[17:44] <Doos> mostly because of all the fancy words
[17:45] <Frank> I'm ok now with the theory...I'm not so sure on which stones colours are caused by which method
[17:45] <Doos> that is a large list
[17:45] <Frank> yes :)
[17:45] <Doos> maybe I'll create one one day
[17:46] <Doos> or you :)
[17:46] <Frank> are some stones coloured by more than one cause?
[17:46] <Doos> I'm sure they will, although I cant think of any at the moments
[17:46] <Frank> for example the iron in Sapphire is a transition element but can also be involved in charge transfer
[17:46] <Doos> but corundum has several causes
[17:47] <Doos> oh yes
[17:47] <Frank> lol...good old corundum
[17:47] <Doos> Cr+3 causes read -> crystal field theory allochromatic
[17:48] <Doos> Mg+2 + hole center -> crystal field -> orange
[17:48] <Doos> Fe+2 + Ti+4 -> molecular orbital theory -> blue
[17:48] <Doos> read = red of course
[17:49] <Frank> of course
[17:49] <Doos> Fe+3 in corundum in large quantities causes yellow
[17:49] <Doos> so also allochromatic crystal field
[17:50] <Frank> is the reason that corundum has so many causes simply because it has been studied in greater depth...don't you think other speces groups might be just as complicated
[17:50] <Doos> yes I would think so

[17:50] <Frank> except maybe the idiochromatics
[17:50] <Doos> and even in corundum the exact mechanisms are not all known
[17:51] <Doos> if Ti, Fe, Mg etc are all present in one stone, things get even more complicated
[17:51] <Frank> I can imagine
[17:51] <Doos> because some elements favour eachother
[17:52] <Doos> but I'm not going to worry my pretty head about that too much .. I know it's there
[17:53] <Doos> so that's about it
[17:54] <Frank> yes I think I have it
[17:54] <Doos> diagrams are handy
[17:54] <Frank> What about band theory?...what is it?...or do you want to leave that for another day?
[17:54] <Doos> maybe for when you get back
[17:54] <Frank> yes a drawing can beat a thousand words
[17:55] <Frank> ok thanks...I hate to miss anything :)
[17:55] <Frank> what will you do for the next two weeks
[17:55] <Frank> if no one comes it'll be a bummer
[17:55] <Frank> not even annie to talk catfood with
[17:55] <Doos> dunno
[17:56] <Doos> maybe take a holiday aswell
[17:56] <Frank> good idea
[17:56] <Doos> drink some beer in the garden
[17:56] <Doos> :)
[17:56] <Frank> even better idea