[00:04] <Doos> so shall we start?
[00:04] <dav> yes sir.
[00:04] <Frank> ok
[00:04] <Doos> Annutara, Sara .. still with us?
[00:04] <Doos> so where were we and does anyone have questions?
[00:05] <dav> no
[00:05] <Frank> no
[00:05] <Doos> ok then
[00:05] <Doos> last week we discussed some fundametals on atoms etc
[00:06] <Doos> we learned that electrons can leave their orbitals when enough energy is provided to them
[00:06] <Doos> the energy comes in the form of photons
[00:06] <Doos> photons are small packets of light (electromagnetic parcels)
[00:07] <Doos> when enough energy is absorped by the electron, it moves to a higher orbital .. or energy state
[00:08] <Doos> but it would stay in the atoms orbitals
[00:08] <Doos> right?
[00:08] <dav> yes
[00:08] <Frank> right
[00:08] <Frank> question
[00:08] <Doos> shoot
[00:09] <Frank> if we have an element where the outer orbital is full (say an inert gas) would the electrons still jump to the next theoretical orbit?
[00:09] <Doos> uhm, good one
[00:09] <Doos> dunno
[00:09] <Frank> k
[00:09] <dav> under special conditions.
[00:10] <Doos> go ahead dav if you have the answer
[00:10] <dav> salts of Ar and Ne had been prepared in labs
[00:10] <dav> u can consult a chemistry book but under normal conditions they are inert/noble gases.
[00:11] <dav> end
[00:11] <Doos> thanks
[00:11] <dav> ok
[00:11] <Frank> ty
[00:11] <Doos> ok so
[00:12] <Doos> if the electron would absorp more energy it would eventually be able to jump out of the atoms orbitals and join another atom
[00:12] <Doos> simply put
[00:12] <Doos> so the atom looses one electron and will have a positive charge
[00:13] <Doos> (one proton more than electrons)
[00:13] <Frank> yes
[00:13] <Doos> at that moment the atom becomes an ion
[00:13] <Doos> in this case a cation
[00:13] <Doos> anions carry a negative charge
[00:14] <Doos> this will force the atom that donated the elctron and the one that accepted the electron to form bonds
[00:15] <Doos> the covalent - inoicvalent story
[00:15] <Doos> ionic
[00:15] <Doos> so electrons move freely when enough energy is applied
[00:15] <Doos> and they return aswell
[00:16] <Doos> it is a constant process
[00:16] <Doos> the key thing to remember is "charge compensation"
[00:16] <Doos> write that down

[00:17] <Doos> done?
[00:17] <dav> yes
[00:17] <Frank> yes
[00:18] <Doos> okay, then we'll go to IVCT or intervalence charge transfer
[00:18] <Doos> which is a very hard topic, but if you understand the basics.. it's easy
[00:18] <Frank> so are cation and anions attracted to each other electrically?
[00:18] <Doos> yes
[00:18] <Frank> ok
[00:19] <Doos> lets take corundum as an example in IVCT
[00:19] <Doos> because that is the most researched in our profession
[00:20] <Doos> the chemical formula of corundum is Al2O3
[00:20] <Doos> last week I learned you the cross trick
[00:20] <Doos> so now you should be able to tell which is 3+ and which is 2- in charge
[00:21] <Doos> anyone?
[00:21] <dav> Al valency=3; O valency=2
[00:21] <Doos> yes
[00:21] <Doos> so AL = 3+
[00:22] <Doos> in the ideal world corundum is colourless
[00:22] <Doos> if Cr is present, it will turn red as in ruby
[00:23] <Doos> Cr is also 3+ and replace the Al3+
[00:23] <Doos> without much trouble
[00:23] <Doos> in sapphire it is a bit more complex
[00:24] <Doos> the 2 transition elements that are responsible for the blue in sapphire are Iron and Titanium
[00:24] <Doos> in particular Ti4+ and Fe2+
[00:25] <Doos> 4+ and 2+ compensate 2 Al3+'s
[00:25] <Doos> so there is stability in charge
[00:25] <Doos> sounds logical?
[00:25] <dav> yes
[00:26] <Frank> yes
[00:27] <Doos> however Ti4+ is not the most favourable to replace 3+ of Al
[00:27] <Doos> and takes much more energy
[00:27] <Doos> so it drops one electron to the Fe2+
[00:28] <Doos> and then we have Ti3+ and Fe3+
[00:28] <dav> u mean from Fe to Ti, right?
[00:28] <Doos> that is the basics of charge tranfer .. keeping all the ions happy
[00:29] <Doos> uhm
[00:30] <Doos> yes you are correct
[00:30] <dav> ok. 10x.
[00:30] <Doos> and that process continues
[00:30] <Doos> back and forth
[00:31] <Doos> usually Ti4+ - Fe2+ causes colours as blue, green and black
[00:32] <dav> eg of green and black?
[00:32] <Doos> schorl, aquamarine
[00:33] <dav> Aquamarine involves Ti?
[00:33] <Doos> I believe so yes
[00:33] <dav> or Fe2+/Fe3+?
[00:34] <Doos> oops
[00:34] <dav> ?
[00:34] <Doos> schorl and aqua are Fe Fe indeed
[00:34] <Doos> wrong notes

[00:34] <dav> what notes?
[00:34] <Doos> hematite is a black example of Ti - Fe
[00:34] <Doos> the ones I made during the week to give this lecture
[00:35] <dav> oh, right.
[00:35] <Doos> what happens during the process is that the red photons are absorped .. giving an exitiction in the red of the spectrum
[00:36] <Doos> glad you are paying attention dav
[00:36] <dav> ok
[00:36] <Doos> still with us Frank?
[00:36] <Frank> are photons colour specific then?...not "white"
[00:36] <Doos> yes Frank
[00:36] <Frank> yes
[00:37] <Doos> photons carry a specific wavelength, like around 650 for red
[00:37] <Doos> the usual spectrum wavelengths
[00:38] <Frank> and photons of all wavelengths are emmited simultaneously?
[00:38] <Doos> depends on the circumstances .. if the source is white light, then yes
[00:38] <Frank> k
[00:39] <Doos> what I just said about the electron going frm 4+ Ti to 2+ Fe should need some more clarification
[00:40] <Doos> Ti4+ is relatively +1 charged compared to Al3+
[00:40] <Doos> so it act as the donor
[00:40] <Doos> Fe2+ is -1 relative to AL3+
[00:40] <Doos> so it is the acceptor
[00:41] <Doos> so Ti wants to give up 1 electron
[00:41] <Doos> not the other way around
[00:41] <Doos> sorry for the confusion
[00:42] <Frank> so the Ti and Fe redistibute their charges in order to occupy space in the atomic structure of the corundum?
[00:42] <Doos> very good, indeed
[00:42] <Frank> by replacing Al
[00:42] <Doos> yes
[00:42] <Frank> ok
[00:43] <Doos> we call those different charged ions 'aliovalent'
[00:44] <Doos> the ones who have the same charge as Al .. like Cr3+ 'isovalent'
[00:45] <Doos> there are many other configurations like Fe -Fe and Ti-Fe
[00:45] <Doos> Mg for instance can play a role in it aswell
[00:45] <Frank> do all seven colouring elements do this?
[00:45] <Doos> usually giving a orange or yellow colour
[00:46] <Doos> and more
[00:46] <Doos> Si for instance aswell
[00:46] <Frank> ok
[00:46] <Doos> but not all has been studied
[00:46] <Frank> ok
[00:46] <Doos> so stick to the ones that have been studied
[00:47] <Doos> there is also something interesting in the order in which they combine
[00:48] <dav> do u have those known studied cases (summary) as related to d syllabus?
[00:48] <Doos> in corundum you could have Ti, Fe and Mg as impurities
[00:48] <Doos> only outside sources
[00:49] <Doos> studies have shown that Ti prefers Mg2+ over Fe2+ to combine with
[00:50] <Doos> also there are combination between Cr3+ and Mg2+
[00:50] <Doos> which leaves a gap of -1

[00:51] <Doos> that gap is filled with a O1-
[00:51] <Doos> Oxygen
[00:52] <Frank> dont they just combine as a lowest common denominateor?...2xCr3+ and 3xMg2+
[00:53] <Doos> if possible yes
[00:53] <Frank> k
[00:53] <Doos> the latter I don't think so
[00:53] <Doos> the first yes
[00:53] <Doos> that's ruby
[00:54] <dav> ques, pls.
[00:54] <Doos> yes
[00:54] <dav> in ruby there is IVCT or allochromatism?
[00:54] <Doos> no IVCT in ruby
[00:54] <dav> ok.
[00:55] <Doos> just the replacement of Al by Cr
[00:55] <Frank> so it's an impurity and not part of the atomic structure?
[00:55] <Doos> ofcourse some others may play a role in it, like Cr-Mg but primary Cr
[00:55] <Frank> or an impurity and part of the atomic structure
[00:55] <Doos> the latter Frank
[00:56] <Frank> wouldn't that make it idiochromatic?
[00:56] <Doos> lol, purist
[00:57] <dav> ie, not an essential part of the structure, Frnk.
[00:57] <Frank> ok
[00:57] <Doos> just because I force myself on your dinner table doesn't make me one of your family members
[00:57] <Frank> good analogy
[00:58] <Doos> the Cr3+ - Mg2+ combination that gives pink leaes one electron missing
[00:58] <Doos> leaves
[00:58] <Doos> because the 2Al combination requires 6+ in total
[00:59] <Doos> the electron gap is called a 'hole'
[00:59] <Doos> and is usually compensated by Oxygen 1- in corundum
[01:00] <Doos> so from O2- to O1-
[01:01] <Doos> can you picture that?
[01:01] <Frank> yes
[01:01] <dav> y
[01:02] <Doos> that is really the basic of charge transfer
[01:03] <Doos> any questions?
[01:03] <Frank> no
[01:03] <dav> n
[01:03] <Doos> lol
[01:03] <Frank> at least not till I spend some time thinking about it all
[01:03] <Doos> shall I draw a picture?
[01:04] <Frank> mental visulaisation is ok...but draw if you want...your pics are always most informative
[01:04] <Doos> I meant a mental picture ofcourse
[01:04] <Frank> k
[01:04] <Doos> a real one will come in time
[01:05] <Doos> ok
[01:05] <Doos> corundum = Al2O3
[01:05] <Doos> imagine an Al atom with all kind of electrons orbiting the nucleus
[01:06] <Doos> for simplicity asume that there are 5 atoms in the outer shell (I need to check if that's correct), but assume
[01:06] <Frank> k
[01:06] <Doos> holdon
[01:07] <Doos> other way around .. assume there are 3 in the outer shell

[01:07] <Doos> sorry
[01:07] <Frank> k
[01:07] <Doos> and it wants to have 8 to fill it's shell
[01:08] <Doos> so it needs to gather 5 from somewhere
[01:08] <Doos> right
[01:08] <Frank> yes
[01:08] <dav> y
[01:08] <Doos> or it could just give up 3 and the lower outer shell is fully filled
[01:08] <Frank> yes
[01:08] <Doos> anyway it happens, the Al atom doesn't mind
[01:09] <Doos> giving up 3 is easier than grabbing 5 (requires less energy)
[01:09] <Doos> but where
[01:09] <Doos> then there is an oxygen atom which has the same problem, but it has 6 electrons in its outer shell
[01:10] <Doos> so it needs 2 to fill its outer shell to have 8
[01:10] <Doos> taking 2 is easier than giving 6
[01:10] <Doos> so Al an O meet
[01:10] <Doos> Al gives up 2 electrons to O and O is happy
[01:11] <Doos> but that leaves Al with 1 electron
[01:11] <Doos> so Al needs to search on
[01:11] dav (~dav@213.120.103.105) left irc: dav
[01:12] <Doos> another Oxygen atom comes along and Al donates it's last electron to O
[01:12] dav (~dav@213.120.103.105) joined #go.
[01:12] <dav> sorry close by mistake.
[01:12] <Doos> so now Al is happy and O needs 1
[01:12] <Doos> np
[01:13] <Doos> so now you have Al and 2 O's
[01:13] <Doos> on O with a shortage
[01:13] <Doos> if you would add another Al and another O they would even out
[01:14] <Frank> yes
[01:14] <Doos> so 2Al's can give up 6 electrons and 3 O's can take 6 electrons
[01:14] <Doos> now imagine the same, but replace one Al with Ti4+ and the other Al with Fe2+
[01:15] <Doos> some thing
[01:15] <Frank> yes
[01:15] <Doos> 'charge compansation' is the key
[01:15] <Doos> now imagine Mg2+ and Cr3+
[01:15] <Frank> they have to balance to be stable?
[01:16] <Doos> yes at all times, that is what they are after
[01:16] <Frank> k
[01:16] <Doos> so Mg2+ and Cr3+
[01:16] <Doos> that give 1 electron missing
[01:16] <Doos> a 'hole'
[01:17] <Doos> that is compensated by a O1- atom
[01:18] <Doos> holdon, I think I have a pic of that .. lemmy quickly find it
[01:19] <Doos> http://www.minsocam.org/MSA/collectors_corner/arc/img/NassauF4.gif
[01:19] <Doos> that is for quarz
[01:19] <Doos> Si4+ and O2-
[01:20] <dav> good pic.
[01:20] <Frank> yes
[01:20] <Doos> kurt nassua

[01:20] <Doos> nassau
[01:20] <Doos>
http://www.minsocam.org/MSA/collectors_corner/arc/color.htm
[01:20] <Doos> read that
[01:21] <Doos> now you should be able to understand those articles
[01:23] <Doos> another thing you should try to get your hands on is 'Gems and gemology, summer 2003' by the GIA
[01:26] <Sara> Do you have a copy? You could scan it ...
[01:26] <Doos> it's so large
[01:26] <Sara> How large?
[01:26] <Doos> 30 pages orso and lots of colorplates
[01:26] <Sara> Oh, I see
[01:26] <Doos> for $20 it's yours
[01:27] <Sara> US?
[01:27] <Doos> yes orso
[01:27] <Sara> ok
[01:28] <Doos> $12 in the us
[01:28] <Sara> Sorry for disappearing, is the 'round table discussion' coming to a close?
[01:29] <Doos> dunno
[01:29] <Doos> I have not much to add
[01:29] <Sara> everyone got here early
[01:29] <Frank> I've got the IVCT pretty clear I think...do you want to carry on or leave it till next week?
[01:30] <Doos> next week maybe .. but I have little more on my agenda on it
[01:30] <Doos> maybe for clarification?
[01:30] <Frank> ok we can think about it and ask questions next week...what subject do you want to do next?
[01:30] <Sara> That sounds good. That way I can go over the log and if I have any questions i can bring them up then
[01:31] <Doos> uhm .. critical angle perhaps?
[01:31] <Frank> ok
[01:31] <Doos> or is that understood?
[01:32] <Sara> dav? annu?
[01:32] <dav> when do u think we do treatments?
[01:32] <Frank> I don't mind doing it again...its all reinforcing the knowledge
[01:32] <dav> maybe after RI....
[01:33] <Doos> I'm not the best on treatments, but hey .. I can try
[01:33] <dav> I bet u r!!!
[01:33] <Doos> lol
[01:33] <Sara> Do you think that Barbra might be able to come?
[01:33] <Doos> she is working