

<Spauwe> ok, now I have the chance

<Spauwe> I asked you before but you were cut off in your answer

<Spauwe> colour centers

<Spauwe> electrons disappear

<BrianQ> oh yeah, what about 'em?

<BrianQ> no

<Spauwe> and cause a imbalance

<Spauwe> no?

<BrianQ> no electrons disappear... they shift onto something else

<Spauwe> ok

<Spauwe> displaced

<BrianQ> better

<Spauwe> now what exactly causes absorption

<Spauwe> the loose electron flying around?

<BrianQ> recall that it takes a lot of energy, a high frequency to excite hydrogen atom to its first excited state?

<Spauwe> yesh

<BrianQ> remember... deep ultraviolet?

<Spauwe> VUV

<BrianQ> yes

<BrianQ> this is true for most other atoms

<BrianQ> as well

<Spauwe> ok

<BrianQ> only one really can be excited with visible light, and that is the famous Na

<BrianQ> Now... if you are looking at singly-charged ions, instead of atoms...

<BrianQ> the situation is different

<BrianQ> recall... remove an electron from an atom, you have a singly-charged ion, right?

<Spauwe> yep

<Spauwe> 1+

<BrianQ> Yep, now several ions can be excited from ground state by absorbing a visible photon

<BrianQ> The exact energy of these excitations depends on the neighborhood in which the ion is located

<BrianQ> That's basically what is happening.

<BrianQ> What is an example of a color center?

<Spauwe> ions are created allowing visible light to be absorbed

<Spauwe> amethyst

<BrianQ> That is quartz, right?

<Spauwe> Iron present in SiO<sub>2</sub>

<Spauwe> yes

<DragonStek> i have lots of that too

<BrianQ> Yes, so the SiO<sub>2</sub> atoms arrange themselves in a geometric pattern, right? the crystal structure

<Spauwe> yesh

<BrianQ> They kind of share some of their valence electrons in order to arrange themselves this way

<Spauwe> yesh

<BrianQ> then some interloper Fe atom wants to crash the party.

<BrianQ> He wedges himself in, kicking out (what, a Si or a O, I don't know)

<Spauwe> Si

<BrianQ> But he doesn't quite fit right, and he can't quite share electrons right, and so...

<BrianQ> in order to fit, he has to kind of give one electron away... maybe running around the other side of the crystal.

<BrianQ> He is then an ion, and he has one or more excited states close to ground state, which can be reached with visible light

<Spauwe> they usually find another foreign element willing to cling to that one

<Spauwe> H or so

<BrianQ> Yes, there you are...

<Spauwe> ok

<Spauwe> another example

<Spauwe> smokey quartz

<BrianQ> color center is still iron, or what?

<Spauwe> Al<sup>3+</sup> present in the crystal structure but that isn't enough to provide the brown-grey colour

<Spauwe> irradiation over a long time is needed to have that Al<sup>3+</sup> loose another electron

<Spauwe> then we have what my course calls a hole colour centre

<Spauwe> but there's more

<BrianQ> yes?

<Spauwe> vibronic colour centres

<BrianQ> yes, see that is a bit yucky

<BrianQ> that is what I was afraid you were going to say

<Spauwe> ghehe

<DragonStek> i never heard of that

<BrianQ> water is a vibronic color center, actually

<BrianQ> what color is water?

<Spauwe> colourless

<BrianQ> nope, not if you have enough of it

<Spauwe> black

<BrianQ> nope, it is pretty transparent

<BrianQ> have you never been to a beach with white sand?

<DragonStek> no

<BrianQ> and seen the water at the edge of the beach?

<Spauwe> you want to hear blue

<BrianQ> blue-green, actually

<DragonStek> oh ok

<BrianQ> water is blue-green

<Spauwe> fussy bastard

<BrianQ> so what color does light absorb?

<BrianQ> oops

<Spauwe> red?

<BrianQ> crazy talk

<Spauwe> I got it

<BrianQ> what color does water absorb... yes, red

<BrianQ> but the atoms can't do it... hydrogen we already know needs to absorb VUV to excite

<Spauwe> ok

<BrianQ> and oxygen needs the same, VUV

<BrianQ> so what absorbs the red?

<Spauwe> and no ions there h<sub>2</sub>o is pretty straight forward

<Spauwe> the whole molecule

<BrianQ> The flexing, bending motion of the three atoms is what absorbs the red

<BrianQ> also called vibrational motion

<Spauwe> ok

<BrianQ> or vibronic

<DragonStek> ok

<Spauwe> yep

<Spauwe> in gemstones:

<Spauwe> type 1A diamonds

<BrianQ> stretching, flexing, bending, these motions take up energy (in a quantum mechanical way)

<Spauwe> groups of nitrogen party poopers surrounding a vacancy

<BrianQ> wait...

<BrianQ> we got to finish up this vibronic...

if a molecule can flex and bend, then a crystal can flex and bend and stretch too.

<Spauwe> one wouldn't say so but I believe you

<BrianQ> Some setups allow flexing and bending that can absorb visible light...

<BrianQ> mm.. flexing and bending of crystals is one of the most studied areas of solid state physics

<Spauwe> ok

<BrianQ> Anyways, that is the basic idea, this flexing and bending can absorb quanta of energy corresponding to visible light

<DragonStek> wow learned something , have to read more into that

<BrianQ> it is just messy, because vibronic states tend to lie much closer to each other than electronic states

<Spauwe> messy as in you can't calculate them...

<BrianQ> No... they can calculate them, it is just a messy job to untangle what you see spectroscopically

<BrianQ> Vibronic excitations spread across a spectrum like picket fence posts....

<BrianQ> But what happens when you don't leave any space for the fence boards... all those pickets right next to each other.

<BrianQ> It is hard to differentiate from one picket to the other.

<Spauwe> ok

<BrianQ> Am I looking at the 12 or 13th picket

<DragonStek> oh ok

<BrianQ> that's why it is messy

<DragonStek> so let someone else do it

<BrianQ> yep :)

<Spauwe> ok the example given in my course (that flies over this ion 4 sentences) is that diamond I mentioned above

<BrianQ> anyways, so the 1A diamonds?

<BrianQ> aren't most all diamonds have nitrogen in them?

<Spauwe> 3 nitrogen atoms surrounding a vacancy

<Spauwe> yes type I a as groups

<Spauwe> type I B as dispersed single ions (rare)

<Spauwe> Ila none

<Spauwe> I Ib boron

<Spauwe> it's that Ia they list as an example of vibronic colour centres

<BrianQ> Yes, so basically you have a group of crystals with a carbon missing and three nearest neighbors to that missing spot are filled with nitrogen rather than carbon.

<Spauwe> yep exactly

<BrianQ> Three bigger nitrogens basically take up the space that would be occupied by four carbons, but they have a little space left over

<BrianQ> not enough to fit in a carbon

<Spauwe> ok

<BrianQ> So... still pretty transparent to most visible.

<BrianQ> what is the question about IA?

<Spauwe> what is the relation between such an configuration and flexing?

<BrianQ> configuration is used to describe electron structure in an atom or ion, not to describe atoms in a crystal

<Spauwe> ok fussy B

<BrianQ> heh

<Spauwe> I'm Dutch remember :)

<Spauwe> limited English skills

<Spauwe> can I conclude that the group of nitrogens atoms are more flexible to visible light and therefor absorb?

<BrianQ> Yes, I think so, because they have that little bit of extra space.

<Spauwe> okay

<Spauwe> kewl

<BrianQ> maybe... I don't know for sure, though

<BrianQ> you can think of this flexing as balls connected by springs.

<BrianQ> different crystal are formed by balls (of different sizes) connected by springs (of different stretchyness)

<Spauwe> you still have time?

<BrianQ> a little

<Spauwe> a third colour centre they mention is the vacancy colour centre

<Spauwe> high speed atomic particles have knocked an atom out of place

<Spauwe> normal structure is retained

<Spauwe> but one atom is missing

<Spauwe> this 'causes absorption'

<Spauwe> why?

<Spauwe> same thing?

<BrianQ> Making a much looser connection in that region, so things like to stretch into it

<Spauwe> ok, so no differentiation required here?

<BrianQ> Well, all these absorptions are due to the crystal structure, rather than the atomic structure, per se

<Spauwe> yep

<Spauwe> I see

<Spauwe> nice

<BrianQ> But they represent kind of different stresses on the crystal structure.

<Spauwe> that helped

<BrianQ> like trying to karate chop a block is different from trying to squeeze the block

[22:45] <BrianQ> well, good, glad to help.

[22:45] <BrianQ> sadly, all good things must end

[22:46] <BrianQ> ciao ciao

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01[22:47] <Spauwe> bye bye