Shape descriptions

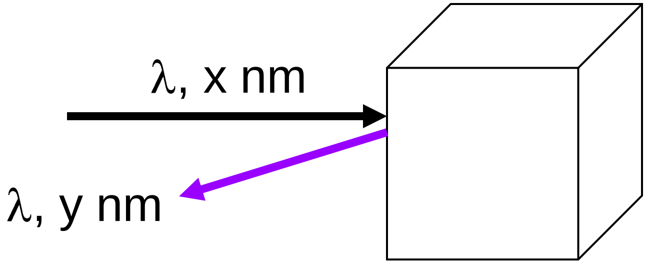
- Different ways to describe the appearance of a crystal or aggregation of crystals not necessarily related to symmetry (though some are a result of that). Table 3.2 in the text – will see in lab
  - Equant, blocky, acicular, tabular or platy, capillary of filiform, bladed, prismatic or columnar, foliated or micaceous
  - Massive, granular, radiating, fibrous, stalactitic, lamellar or tabular, stellated, plumose, dendritic, reticulated, colloform or globular, botryoidal, reniform, mammary, drusy, elliptic or pisoltic

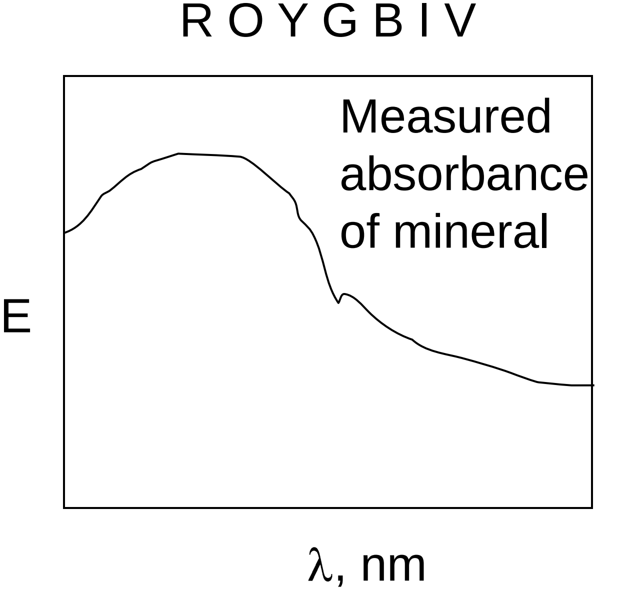
Shape - from breaking

- Cleavage – as we learned, the regular arrangement of atoms results in planes, some of which may be structurally weaker and result in cleavage planes or surfaces
  – Generally described as basal, cubic, octahedral, prismatic
- Fracture - the breaking of a crystal is not related to a plane of atoms in the lattice
- Different types of fracture
  – Even, uneven or irregular, hackly, splintery, fibrous, conchoidal

Color = light - light absorbed

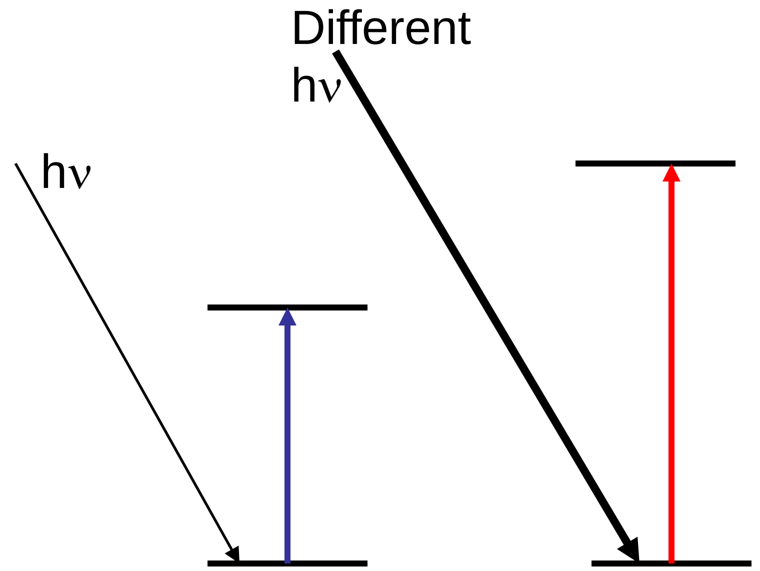
- White light is one part of the full spectrum of particle energy
- Color develops in any material because one part of the spectrum is absorbed more than another part

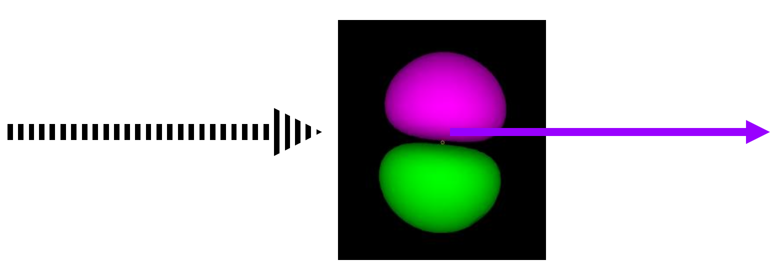




Color = light - light absorbed

- What wavelength of light/ particle gets absorbed?
- Energy= 1/λ
  - – Higher E transition
    - → redder





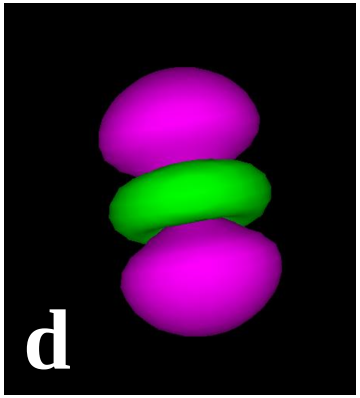
Absorbance

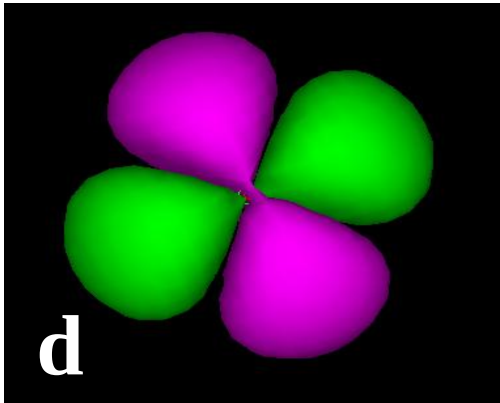
- The absorbance of a mineral (or any material for that matter) can be measured using any wavelength → materials often have very distinct absorbances, why?
- Ions making up certain minerals may be similar, but the bonding and spatial arrangement are different
- Different ions coordinated to other ions in different ways (vary bond order, length, geometry, type) will absorb energy differently

Color in Minerals

- Idiochromatic – color is derived from the main constituents making up the mineral, changes in color then indicate significant changes in composition and structure
- Allochromatic – color is derived from minor or trace ions (present in small amounts)
  - Chromophores are ions which absorb light in visible wavelengths quite strongly

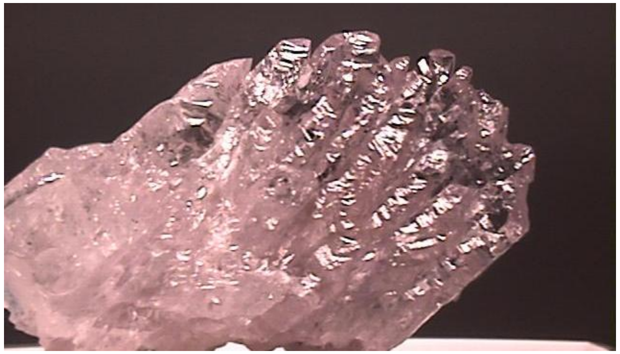
Transition metals are often good chromophores →d-orbitals absorb very well in the visible spectrum





Mineral color (impurity)

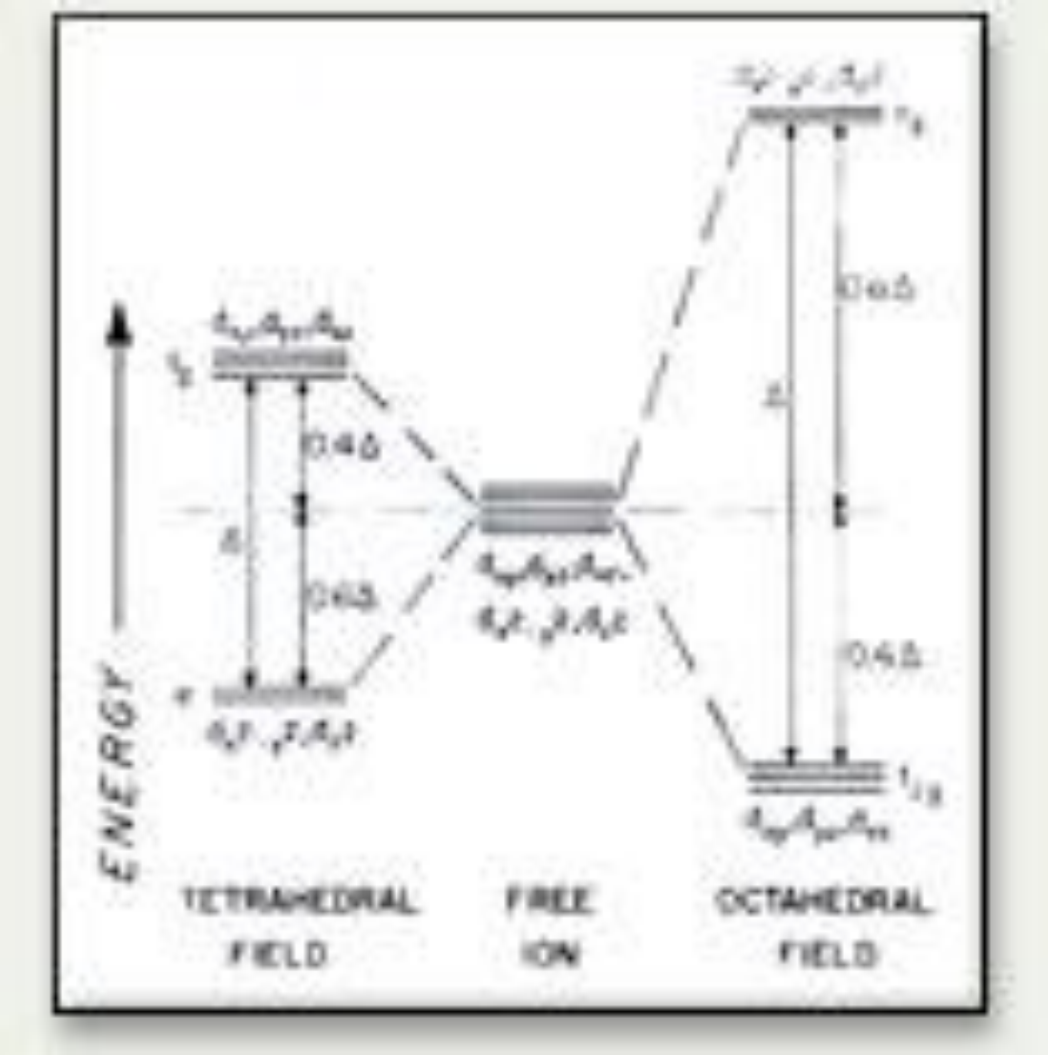
- Quartz is obviously allochromatic
  - Rose Quartz → Fe



Gemstone	Color	Host crystal	Impurity
Ruby	Red	Aluminum oxide (Corundum)	Chromium
Emerald	Green	Beryllium aluminosilicate (Beryl)	Chromium
Garnet	Red	Calcium aluminosilicate	Iron
Topaz	Yellow	Aluminum fluorosilicate	Iron
Tourmaline	Pink-red	Calcium lithium boroaluminosilicate	Manganese
Turquoise	Blue-green	Copper phosphoaluminate	Copper

Same Ion, different color?

- Coordination of the ion can change the energy between stable and excited states (photon emission from this splitting determines absorbance and thus color)



Staurolite is idiochromatic

- Fe gives staurolite its brown color
- Staurolite formula is $Fe_2Al_9Si_4O_{23}(OH)$

Rhodochrosite is idiochromatic

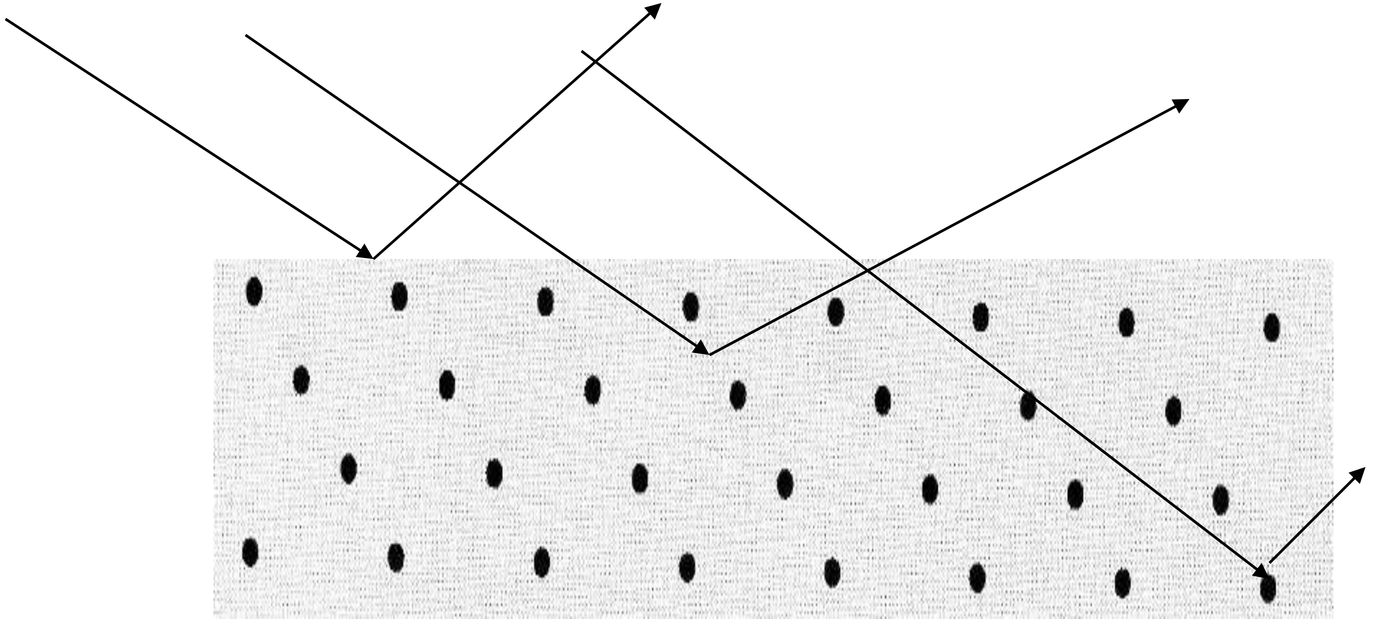
- Mn gives rhodochrosite its cherry red color
- Rhodochrosite formula is $MnCO_3$

Same ion, structure – different color??

- Remember defects?
- Defects are parts of the mineral structure where a ‘foreign’ ion comes in, or where the major ions are simply misfit
- Radiation can also cause defects, or changes in the bonding environment
- Any change in bonding environment can result in a different color

Luster

- Sheen – the WAY in which the mineral reflects light…
- When a particle reflects, interaction can change appearance → luster
- Metallic minerals reflect more light – surface is denser with electrons – some rays reflect totally, other absorb or transmit through

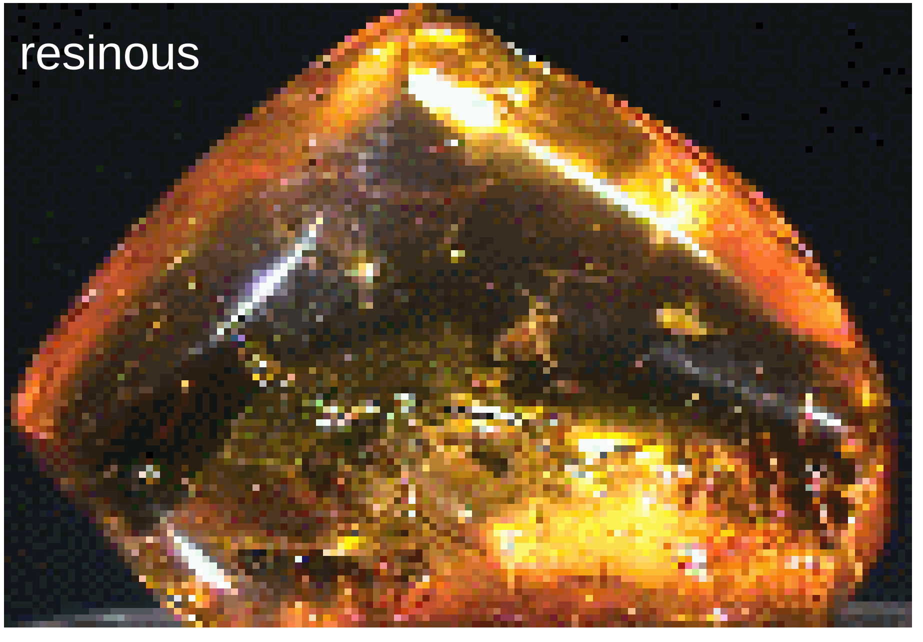


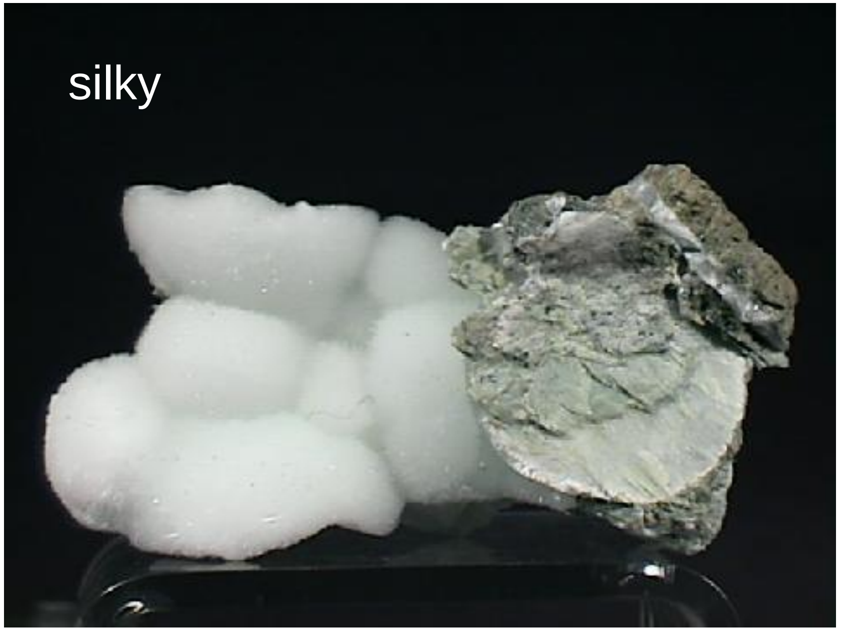
Types of luster

- Vitreous – glassy appearsance
- Resinous – looks like resin
- Greasy – interference creates more than one color reflection (oil on water)
- Silky – surface appears as fine fibers
- Adamantine – bright, shiny, brilliant
- Pearly – irradescent appearance
- Dull – not reflecting a lot of light
- Earthy – looking like earth
- Pitchy – appearance of tar
- Submetallic
- Metallic


vitreous

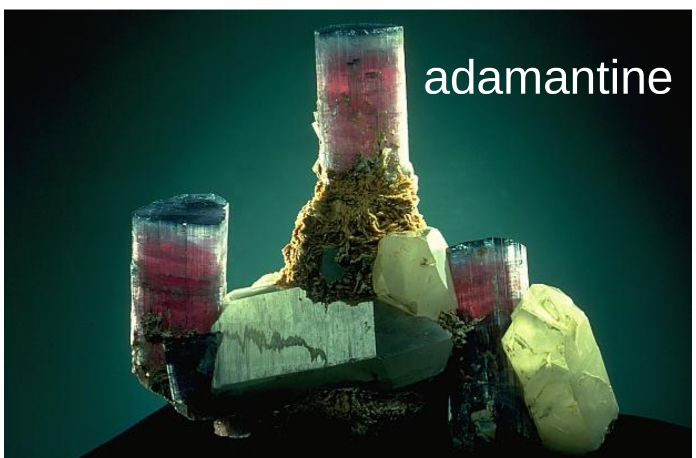

Greasy/waxy


resinous


silky


submetallic


pearly


adamantine


adamantine

Diaphaneity

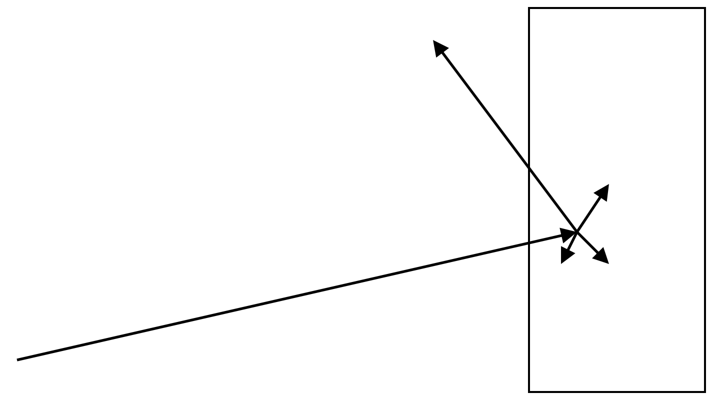
- A mineral's ability to transmit light is termed diaphaneity
- Ranges from transparent (light passes freely) to translucent (light partially passes well, see through thinner crystals) to opaque (light does not pass through unless extremely thin)

Transparent → **Translucent** → **Opaque**

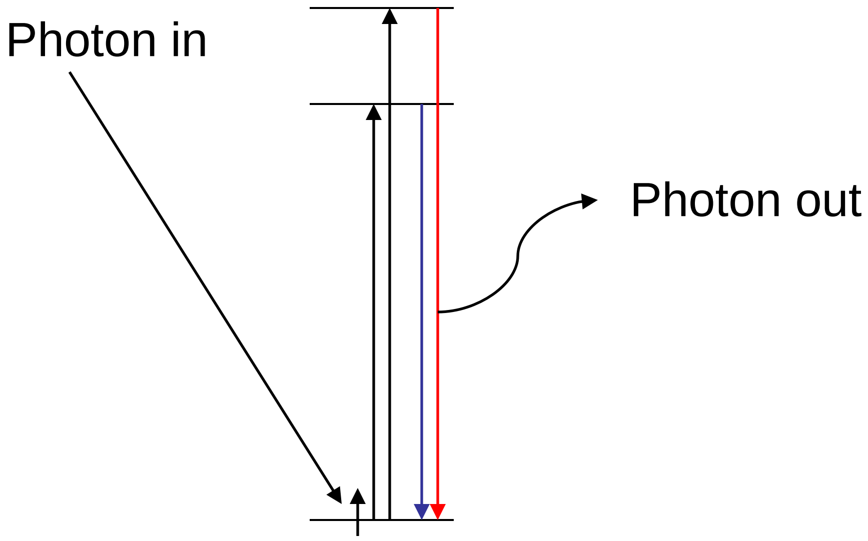
Full transmittance of light → No transmittance of light

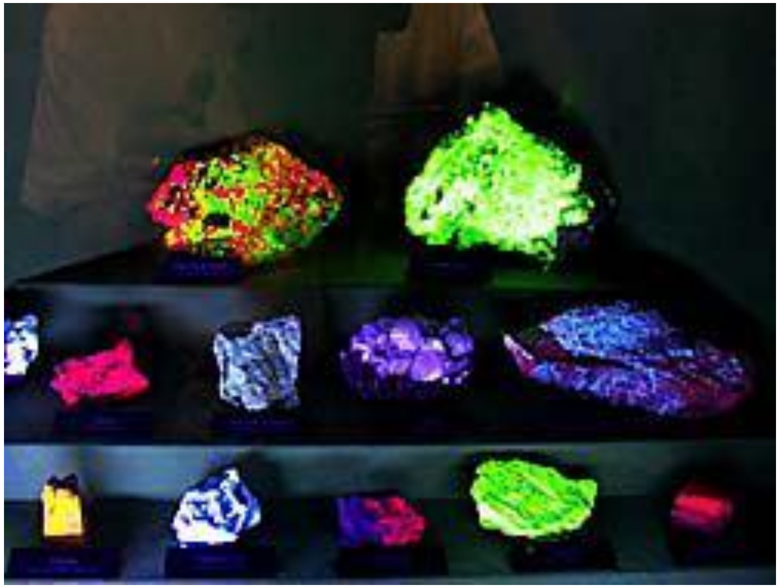
Size and color…

- A material's size can affect how color reflects off of it.
- Streak test is an indicator of this – some minerals (hematite for instance) can be different colors in hand sample, but the streak is always the same
- Sometimes the color is actually a distinctive measure of particle size



Luminescence





Fluorescence – UV light in yields photon emission in the visible
Phospholuminescence – UV light excitation lasts seconds to minutes and releases visible light

Color Centers

- Typically an impurity present which is responsible for color or luminescence development
- When 2 ions are present with different charges, electron transfer between them can act as a color center → Sapphires are blue because Fe^{2+} → Ti^{4+} absorbs red light
  - The energy required to move the electron comes from light in the red part of the spectrum for sapphire