

Solar Cells Synthesis of Titanium Dioxide

What do each of these have in common?

Synthesis of Precursors for Solar Cells

- ▶ Initial solar cells were made by using semiconductors with a transparent layer of gold (very inefficient)
- ▶ Later silicon was used but cell efficiencies was only about 6%.
 - Cell efficiency was increased by doping the silicon to form p-n junctions
 - This method takes lots of time and equipment
 - High temperature synthesis
- ▶ Dye sensitized solar cells increase cell efficiency to ~ 11%.
 - This method offers the alternative of a low temperature synthesis
 - Chemical vapor deposition
 - Sol gel synthesis

Synthesis of Fe₃P

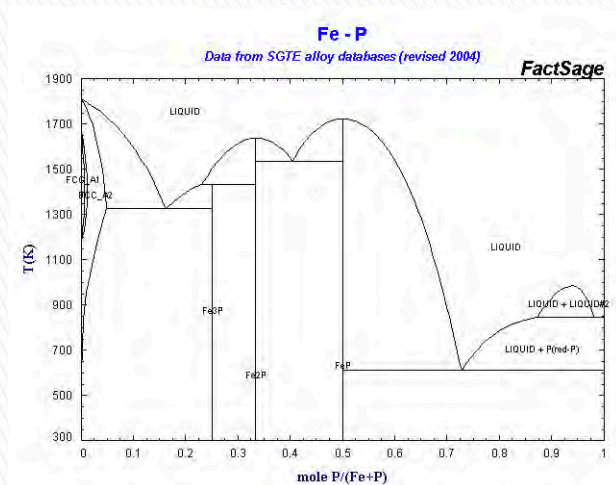
- ▶ Combining iron and phosphorus in stoichiometric amounts and heating to high temperatures $> 1100^{\circ}\text{C}$
- ▶ Problem
 - results in a variety of phases difficult to separate
 - No thin films or nanostructures possible
- ▶ Used to produce high purity thin films
- ▶ Advantages
 - Results in one phase
 - Can produce nanostructures
 - Low temperature synthesis
 - Used to make synthetic diamonds



Solid State

Chemical vapor
deposition

Synthesis of Fe₃P



Stoichiometric amounts of Fe-P are placed in a niobium tube and welded under Argon gas



Sample is placed in a furnace and heated to > 1100 °C for a few hours and slowly cooled to room temperature

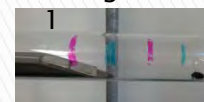
Solid State

- ▶ Two quartz slides are cleaned and pasted onto a steel boat using silver paste. The boat is heated from ~ 135-140 °C for 1.5 - 2 hours to remove any air bubbles.



- ▶ In a clean test-tube 0.01 grams of precursor are placed with the cooled steel boat.

Heating zone



- ▶ The test-tube is attached to a vacuum line and heated to 400 °C (Zone 1) directly above the slides and ~ 30 minutes later heated to 60 - 80 °C (Zone 2) above the precursor.

Chemical Vapor deposition

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Chemical Vapor Deposition vs. Sol-gel synthesis

▶ Chemical Vapor Deposition

- Used to produce thin films
- Low temperature
- Synthesis of a pure phase

▶ Sol – gel Synthesis

- Consists of a solution and a gel phase
- A wet chemical technique
- Low temperature synthesis
- Can be used to form thin films by dip coating or spin coating



Classify each of the following under the category of chemical vapor deposition or made from titanium dioxide.









