6.3.4 Summary to: 6.3 Chemical Vapor Deposition

- Chemical Vapor Deposition (CVD) is simple in principle
  - Find to gases that react ot the desired material at elevated temperatures
  - Put your wafer(s) into some machine, evacuate, heat to the desired temperature (preferably only the wafers) and admit the gases (and remove undesired reaction products).
  - There are many quute different technical ways (all of them expensive) to realize a **CVD** apparatus

- Major **CVD** process are
- Deposition of epitaxial **Si** layers - obviously always on (atomically clean) **Si** substrates. By admitteing some gases carrying doping atoms (e.g. **AsH_3, AsH_3**) the layer can be doped in-situ.
- Depositon of poly crystalline **Si** layers.
  - Chemically similar to epitaxial layers, in reality quite different because the CVD reactos can be simpler.
  - Poly-**Si** is needed for many uses: Gate electrode, interconnect, filling of holes, sacrifical layer.
  - Its great advantage is its ull compatibility with **Si** and **SiO_2**; its great disadvantage is its mediocre conductivity (for heavy doping).
- Deposition of **Si_3N_4**
  - Very important. Always prone to produce mechanical stress (**Si_3N_4** is an unyielding ceramic!).
- **W** (and Silicides, and ...)
  - Not "good" processes, but sometimes unavoidable!

Epitaxial Si layer

$$SiCl_4 + 2\,H_2 \Rightarrow Si + 4\,HCl \quad (1000\,^oC - 1200\,^oC)$$

Polycrystalline Si layer

$$SiH_4 \xrightarrow[630^oC]{60\ Pa} Si + 2\,H_2$$

SiO_2 layer ("TEOS process)

$$Si(C_2H_5O)_4 \Rightarrow SiO_2 + 2H_2O + C_2H_4 \quad (720\,^oC)$$

Si_3N_4 layer

$$3\,SiH_2Cl_2 + 4NH_3 \Rightarrow Si_3N_4 + 2HCl + 1{,}5\,H_2 \quad (\approx 700\,^oC))$$

W layer

$$WF_6 + H_2 \xrightarrow[470^oC]{10^4\ Pa} W + \text{(nasty) gases}$$

Questionaire

Multiple Choice questions to all of 6.3