Epitaxial growth of silicon thin films by low temperature RF-PECVD from SiF₄/H₂/Ar chemistry

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Motivation

**Diffused emitter drawbacks:**
- Difficult to achieve a sharp junction
- Too highly doped regions → Auger recombination
- Additional step of PSG/BSG removal by wet etching

**Suggested solution: Epitaxial emitter**
- Good doping control (by PH₃/B₂H₆ flow rate)
- Better Vₜ and reduction of J₀ expected [1,2] by doping profile optimization

**Advantages of low temperature epitaxy by PECVD:**
- Low dopants diffusion (200°C process)
- Sharp junction
- Low thermal stress
- Easy scale-up and integration in industry

**SiF₄/H₂/Ar plasma chemistry advantages:**
- Better understanding based on a phenomenological model [5]
- Lower amount of oxygen incorporated in the layers [6]
- Better crystallinity and lower defects density expected [7],[8],[9]
- Very smooth interface between the wafer and the epitaxial layer [10]

**Intrinsic epitaxy**

- Thick high quality epitaxial layers achieved
  - 2.5µm thick epitaxy with a very smooth interface has been achieved and diffraction patterns show no differences.

**Doped epitaxy**

- n doping of epitaxial layers
  - Strong effect of PH₃ on epitaxy even for low concentration (0.1%)

- p doping of epitaxial layers
  - Lower effect of B₂H₆ on epitaxy even for higher concentration (1%)

**Solar cell and perspectives**

- Hall effect measurement
- XRD study of doped epitaxial thin films
- Improvement of uniformity

**References**