E-MRS Spring Meeting 2002
June 18 - 21, 2002
Symposium D
Contribution D/PI.42

ArF-excimer laser induced chemical vapour deposition of amorphous hydrogenated SiGeC films

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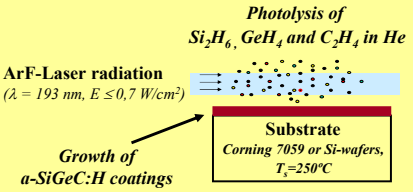
ArF-excimer laser induced Chemical Vapour Deposition (ArF-LCVD)

Advantages

* Allows single chamber processing
* Low thermal budget technique
* Fast process with acceptable growth rates
* High control of the deposition rate
* Useful for a large variety of materials

ArF-LCVD in parallel configuration



a-SiGeC:H thin films

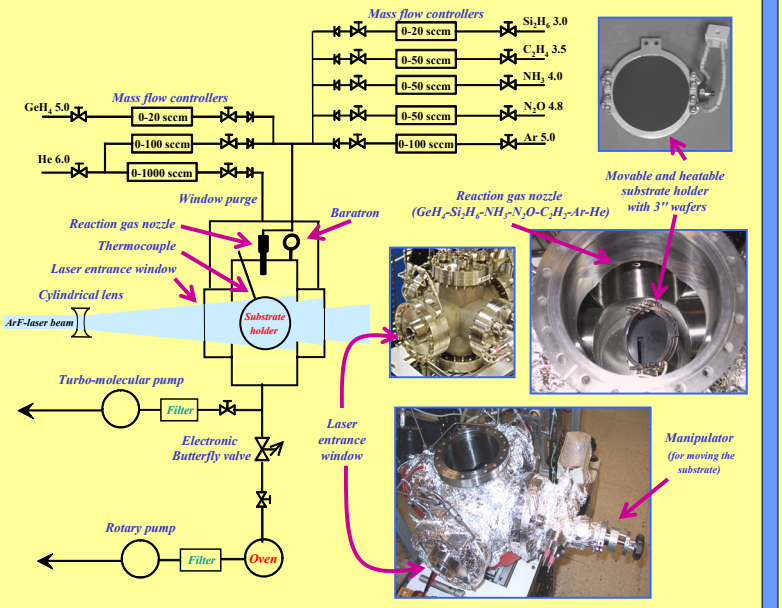
Properties and Advantages

* High absorption coefficient
* Adjustable band gap
* Easy to micro-machine
* Uniform precursor for crystallisation processes

Applications

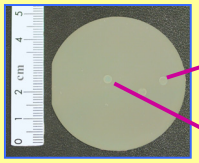
* Detectors, Solar cells, Microelectronic devices

Experimental Set-up for ArF-LCVD on 3" wafers



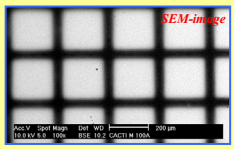
Homogeneity of the a-SiGeC:H coatings

2" wafer uniformly coated with a 400 nm thick a-SiGeC:H film

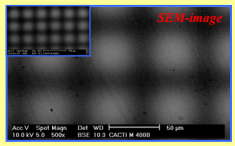


using masks and due to the pure photo-induced process

a-SiGeC:H in small areas

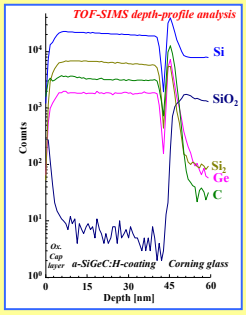


(200 x 200 μm² micro-squares)



(dots with ∅=50 μm)

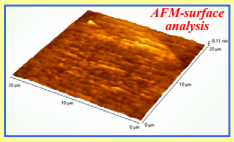
Depth-profile analysis of a ~40 nm thin a-SiGeC:H film



Homogeneous distribution of elements

and

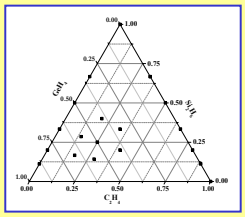
very smooth surfaces



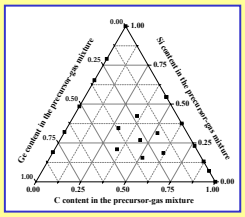
Roughness < 2 nm RMS

Variation of stoichiometry through adjustment of gas flow rates

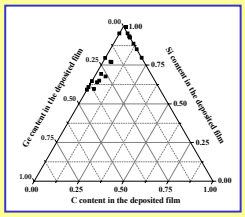
Ratios of gas flow rates (Si_2H_6, GeH_4, C_2H_4)



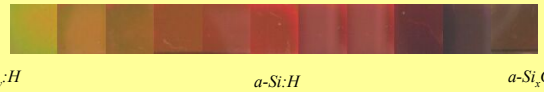
Ratios of the Si/Ge/C-content in the gas mixture



Ratio of Si/Ge/C in the film (determined by XPS)



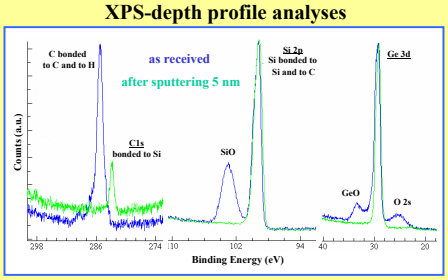
Images of samples with different SiC and SiGe content deposited on Corning glass clearly indicate tailoring of the optical band gap



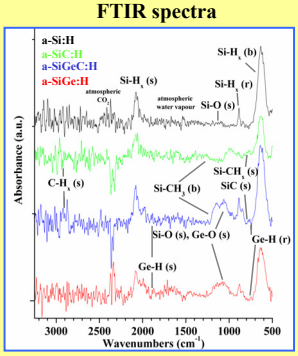
a-Si_xC_y:H *a-Si:H* *a-Si_xGe_y:H*

Composition of the coatings

XPS-depth profile analyses



FTIR spectra



* 5 nm thick native oxide cap-layer
* Si, Ge and C bonded to Si
* FTIR - peaks and bands related to
  - ➡ Si-H, Ge-H and C-H vibrations indicate highly hydrogenated films
  - ➡ Si-C vibration confirms the formation of SiC
  - ➡ Ge-O and Si-O vibrations from native oxides on wafer and/or coating

Conclusions

* **Amorphous hydrogenated SiGeC alloys (a-$Si_xGe_yC_z$:H) have been produced using ArF-LCVD**
* **Uniform coatings can be grown on large areas**
* **Well defined small regions can be coated using masks**
* **Roughness of the coatings is extremely low**
* **Elements are homogeneously distributed in depth**
* **Oxygen contamination is only detectable in a thin native oxide cap-layer**

Acknowledgements

This work has been partially supported by EU as well as by Spanish contracts and grants HA1999-0106, PR405A2001/35-0, MAT2000-1050, XUGA32107BB92DOG211, UV62903I5F4 and PGIDT01PX130301PN.

The authors wish to thank U.Kosch (FH-O/O/W-Emden), J.B.Rodríguez (CACTI, Univ. Vigo) and A.Abalde for their extensive technical help and fruitful discussions. TOF- SIMS measurements have been performed by Scott Bryan (Physical Instruments Minneapolis).

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