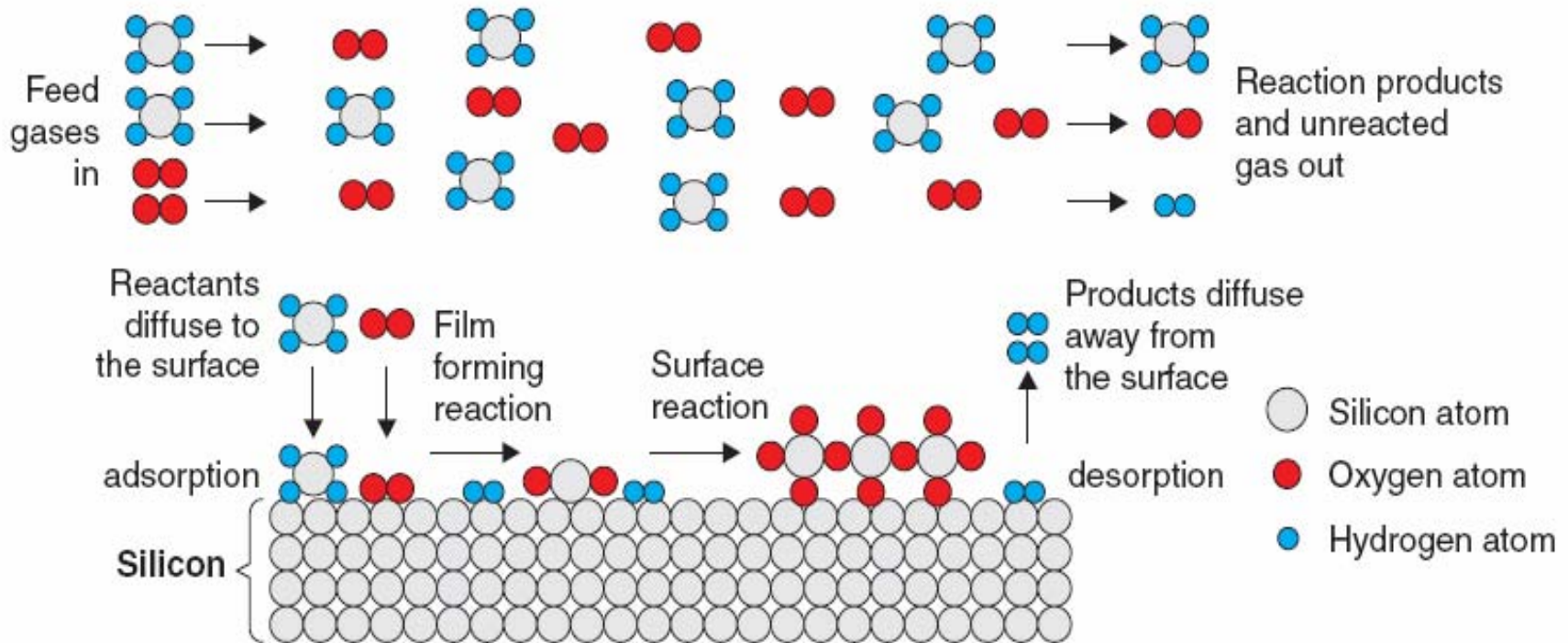


Plasma Enhanced Chemical Vapor Deposition (PECVD)

Pathros Cardenas & David Tung

What is Chemical Vapor Deposition?



CVD deposition of silicon dioxide from silane.

From: http://www.icknowledge.com/our_products/Chapter%204.pdf

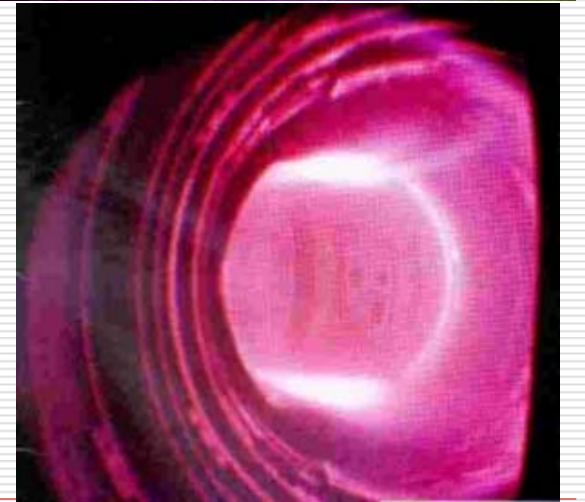
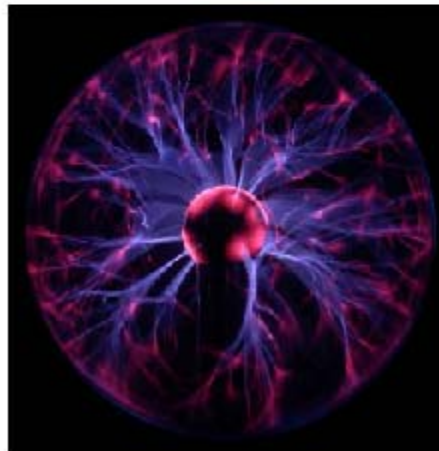
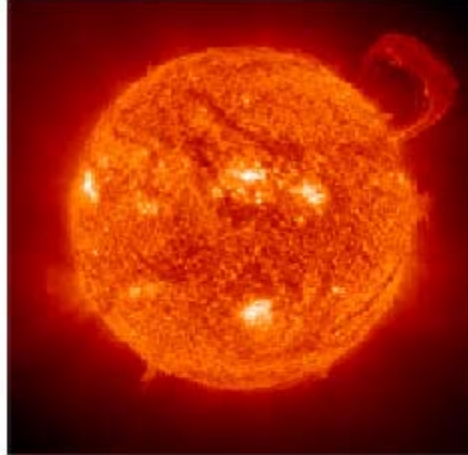
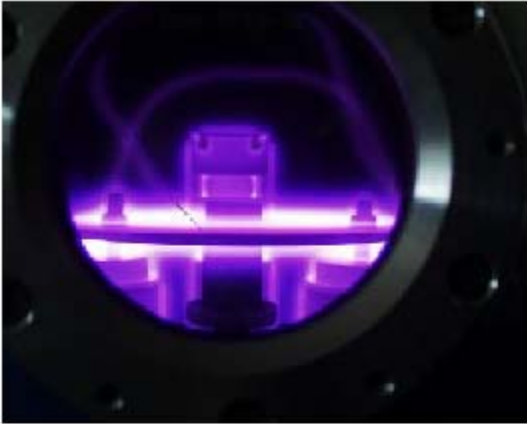
What is Plasma Enhanced Chemical Vapor Deposition?

- ❑ CVD process that uses plasma
 - ❑ Uses cold plasma
 - ❑ Keeps wafers at low temperatures
 - ❑ Enhances properties of layers being deposited
-

What is a Plasma?

- ❑ Ionized gas
 - ❑ High free electron content
 - ❑ Unique state of matter
 - ❑ Electric fields energize plasma
 - ❑ Cold plasma (not in thermal equilibrium)
-

Where can we find Plasma?



The Reaction

- Gas is introduced
 - Ionized by plasma
 - Diffusions of particles through sheath
 - Electron bombardment onto substrate
 - Absorption of particles
 - Layer formation
-

PECVD Reactors

- Parallel plate reactor
 - Inductive coupling reactor
 - Advanced parallel plate reactor
 - Tubular reactor
-

Parallel plate reactor

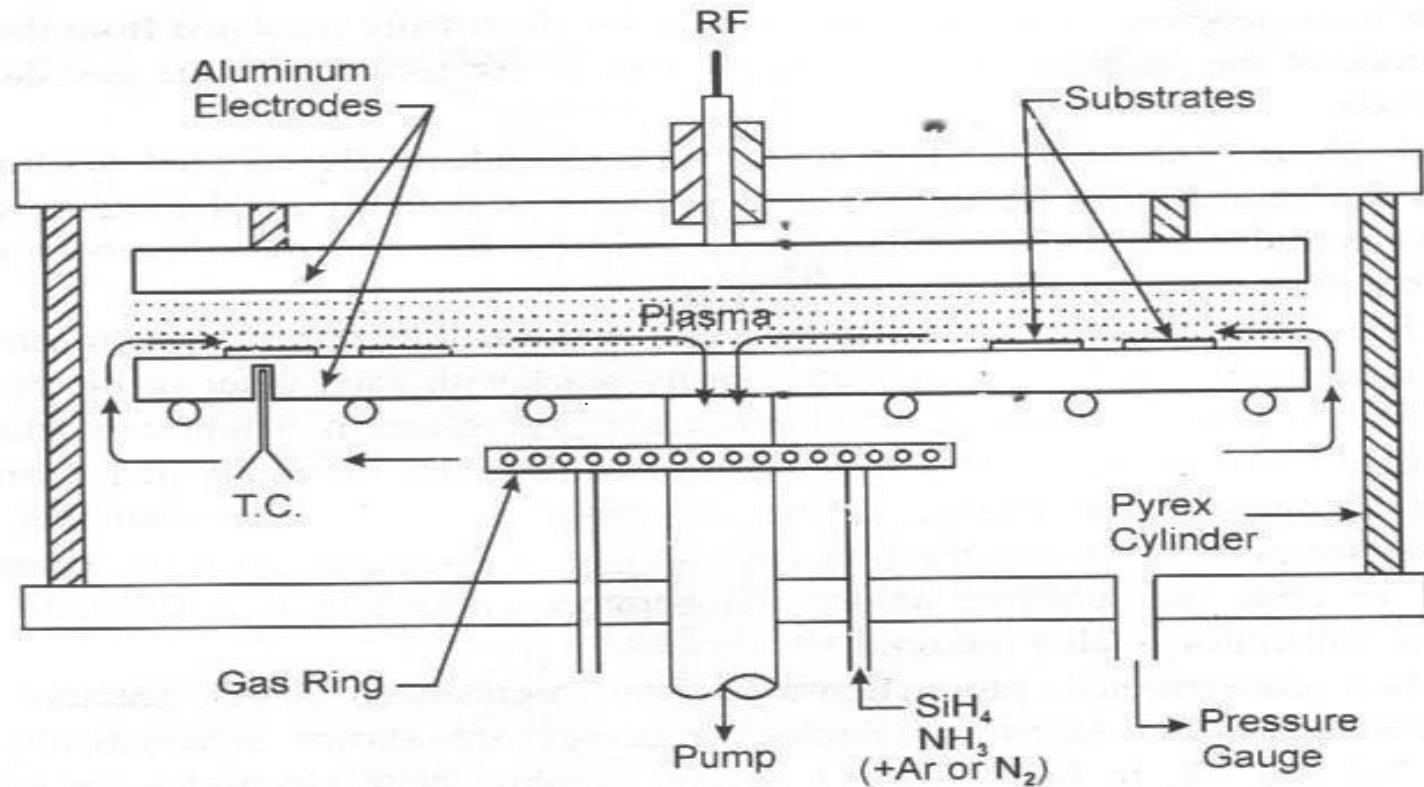
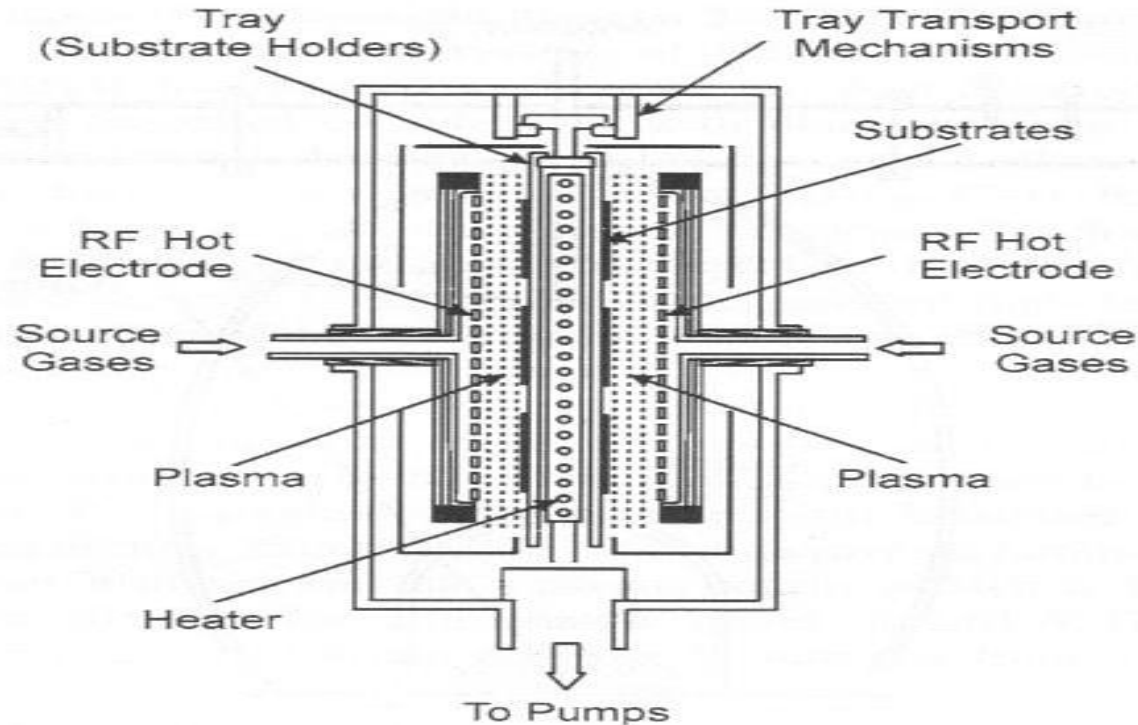


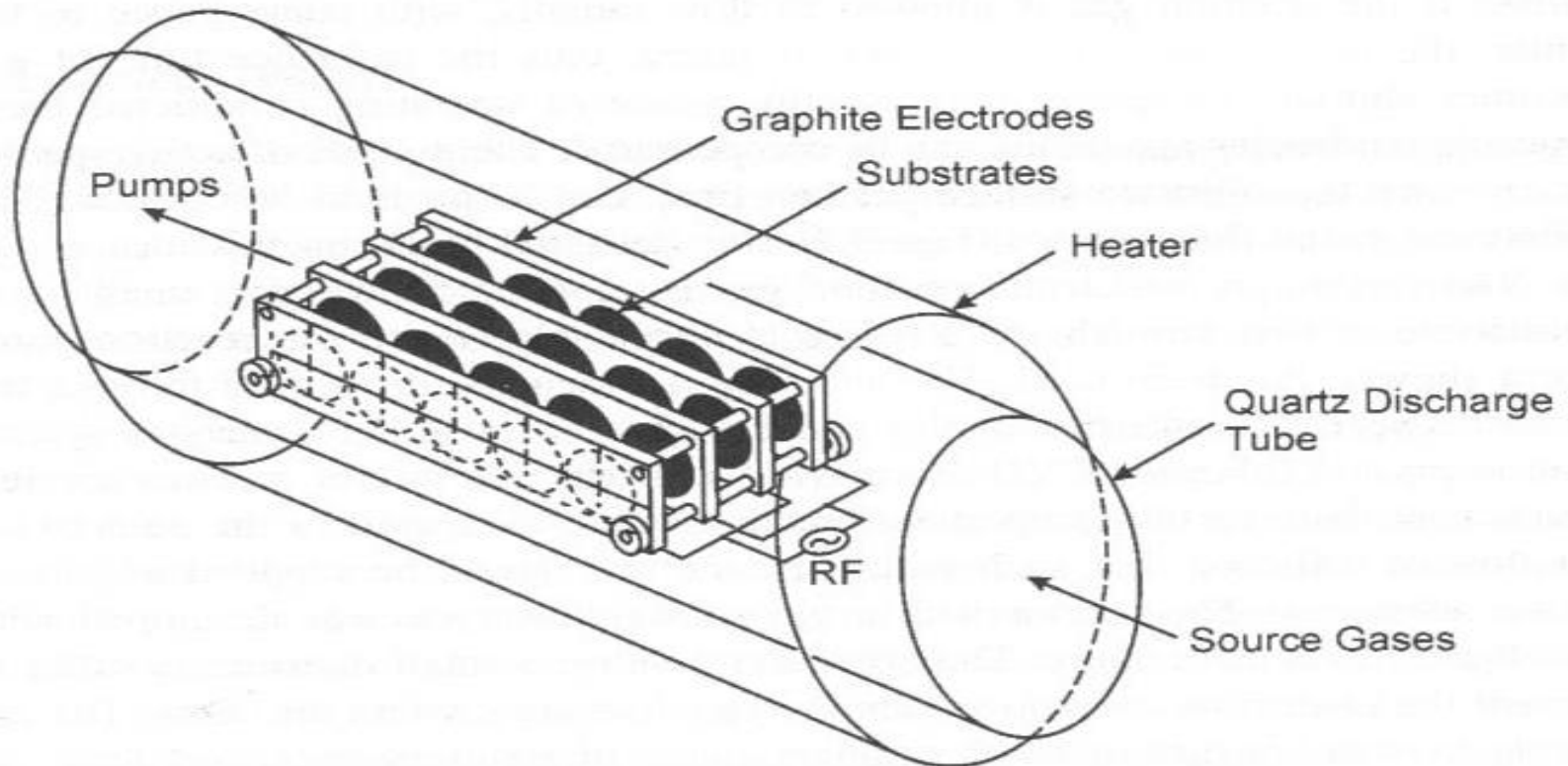
Fig. 1 A parallel-plate reactor in which the reaction gases flow radially [3].

Advanced parallel plate reactor

□ Double sided vertical holder reactor



Tubular reactor



Advantages of using PECVD

- Low operation temperature
 - Lower chances of cracking deposited layer
 - Good dielectric properties of deposited layer
 - Good step coverage
 - Less temperature dependent
-

Disadvantages of using PECVD

- Toxic byproducts
 - High cost of equipment
-

Applications

- Deposition of silicate layers
 - Deposition of dopants
 - Anti-reflection and anti-scratch layers in optics
 - Solar cells -> amorphous silicon
-

Conclusion

- ❑ PECVD is not a replacement for CVD
 - ❑ PECVD can give better layer quality than CVD
 - ❑ PECVD has a wide variety applications
 - ❑ PECVD process costs can be prohibitive
-

References

- ❑ 1. "Chemical Vapor Deposition." Wikipedia. 27 Sept. 2007. 11 Oct. 2007 <http://en.wikipedia.org/wiki/Chemical_vapor_deposition>.
 - ❑ 2. Jaeger, Richard C. Introduction to Microelectronic Fabrication. 2nd ed. Vol. 5. Upper Saddle River, NJ: Prentice Hall, 2002. 136-141.
 - ❑ 3. Konuma, Mitsuharu. Film Deposition by Plasma Techniques. Berlin: Springer-Verlag, 1992.
 - ❑ 4. Konuma, Mitsuharu. Plasma Techniques for Film Deposition. Harrow, U.K.: Alpha Science International Ltd., 2005.
 - ❑ 5. "PECVD Process." MicroFAB BREMEN GMBH. 17 May 2004. 14 Oct. 2007 <<http://www.microfab.de/services/pecvd.htm>>.
 - ❑ 6. "Plasma (Physics)." Wikipedia. 15 Oct. 2007. 12 Oct. 2007 <http://en.wikipedia.org/wiki/Plasma_%28physics%29>.
 - ❑ 7. "Plasma-Enhanced Chemical Vapor Deposition." Wikipedia. 30 Aug. 2007. 11 Oct. 2007 <http://en.wikipedia.org/wiki/Plasma_Enhanced_Chemical_Vapor_Deposition>.
 - ❑ 8. "Plasma Enhanced CVD." Hitech-Projects. 2007. 14 Oct. 2007 <<http://www.hitech-projects.com/dts/docs/pecvd.htm>>.
 - ❑ 9. Sherman, Arthur. Chemical Vapor Deposition for Microelectronics Principles, Technology, and Applications. Park Ridge, NJ: Noyes Publications, 1987.
-

QUESTIONS?
