

NSF/SRC CEBSM

Teleconference

February 24, 2000

**Distance Course Delivery
and
Student-Instructor Interaction**

**Greg Raupp
Arizona State University**

CHE 458/598

Semiconductor

Materials Processing

- **Senior / grad technical elective**
- **Unit processes of semiconductor manufacturing**
- **Emphasis on understanding through 1st Principles modeling**

Delivery Modes

- **Live in ASU studio**
- **Television**
 - **ITFS remote site network**
 - **NTU**
- **Live WebCast**

Student Diversity

- Undergraduate
- Graduate: Ph.D., M.S., non-thesis Masters (SPM Program)
- Full-time students, part-time students, full-time professionals
- Disciplines: CHE, MSE, EE, IE, CHM, PHYS

Course Web Site

- All students access the site for announcements, course materials incl. lecture slides, assignments, communication
- Two-step initial access process:
 - navigate to <http://asuonline.asu.edu>, select CHE 598 and Register
 - Once at course site, click Enroll

Blackboard CourseInfo 4.0

- **ASU site license through DLT**
- **provides uniform look, features, structure**
- **data-based structure -- no need for HTML expertise**
- **<http://www.blackboard.net>**

Web Site URL

<http://www2.dlt.asu.edu:7500/courses/20001CHE598>

You are welcome to visit the site!

Two guest accounts are available --

Username: CEBSMGuest1 *and* CEBSMGuest2

Password: green



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20001CHE598: Semiconductor Materials Processing



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Subject: Announcement

Posted by Gregory Raupp on Jan 10, 2000

Welcome to the CHE 458/598 Semiconductor Materials Processing CourseInfo Web Site. The live WebCasts can be accessed through Course Documents. Please take a few moments to browse through the rest of the site so that you are able to access the learning and communications resources you need.

I look forward to working with you this semester.

- Greg Raupp

Subject: Announcement

Posted by Gregory Raupp on Jan 10, 2000

If you have questions with the content of the course during a live class session, or if you are experiencing technical difficulties with signal transmission/receipt at your remote site, you may phone in to the studio at (480) 965-4487. Your call will first be screened by our studio technician. If you have a question for me, you will be patched forward to the lecture desk. At that time I will answer the phone, and all students will be able to hear your question.

- Greg Raupp

Subject: Announcement

Posted by elaine on Jan 10, 2000

In addition to the Web-cast archive, ITFS broadcast-quality archived videos of the class are maintained by the Library on VHS tapes, and can be viewed by contacting University Libraries Video Resources at (480) 965-5046. Videotaped class sessions are available for the entire semester.

- Greg Raupp

ASU ARIZONA STATE UNIVERSITY

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Gregory Raupp

Course Information

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Current Location: Course Information



[Syllabus](#)



[Your Instructor](#)



System Requirements for Online Video

[Link to File](#)

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Communication Center



Send E-Mail



Student Roster



Student Pages



Discussion Board



Virtual Chat



Group Pages

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Student Tools



Student Drop Box



Change Your Information



Check Your Grade



Edit Your Homepage



Student Calendar



Student Manual

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Current Location: Course Documents

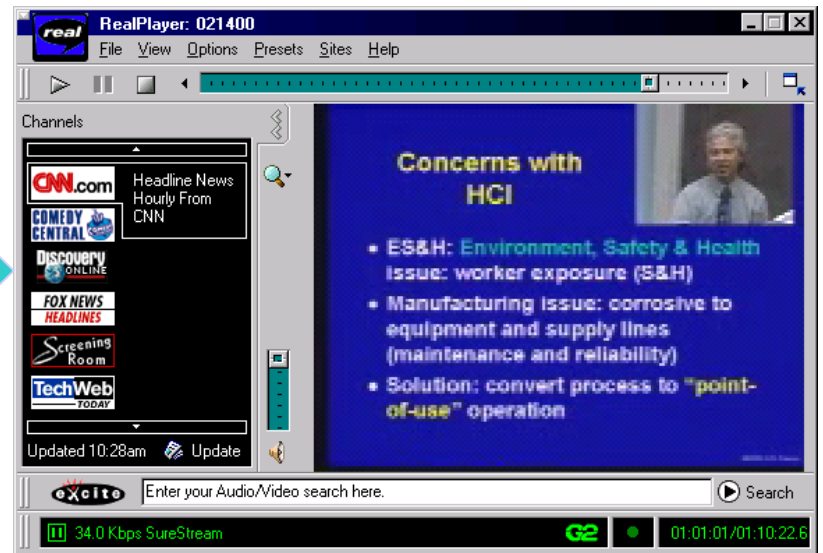
 **Live WebCast**
CHE 598 is WebCast live Monday and Wednesday from 6:40-7:55pm MST.



The archived version of the class video will be available within 24 hours of the original class time.

Consult "System Requirements for Online Video" in Course Information for more information.

-  [WebCast Archive](#)
-  [Powerpoint Files](#)
-  [Supplementary Learning Modules](#)



RealPlayer: 021400
File View Options Presets Sites Help

Channels

- CNN.com: Headline News Hourly From CNN
- COMEDY CENTRAL
- Discovery ONLINE
- FOX NEWS HEADLINES
- Screening Room
- TechWeb TODAY

Updated 10:28am Update

Concerns with HCI

- ES&H: Environment, Safety & Health Issue: worker exposure (S&H)
- Manufacturing Issue: corrosive to equipment and supply lines (maintenance and reliability)
- Solution: convert process to "point-of-use" operation

Excite Enter your Audio/Video search here. Search

34.0 Kbps SureStream G2 01:01:01/01:10:22.6

*16 fps
low resolution*

Course Information

[[Top](#)] :

System Requirements for Online Video - [Link to File](#)

PC	MACINTOSH
<ul style="list-style-type: none"> • Windows 95, Windows 98, or Windows NT 4.0 with Service Pack 3 • 120 MHz or faster Intel Pentium processor (or equivalent) • 32MB of RAM or more • 28.8 Kbps modem or faster (56.6 Kbps modem or faster connection recommended) • 16-bit sound card and speakers • 65,000-color or better video display card • Internet connection and web browser • 30 MB free space on your hard disk 	<ul style="list-style-type: none"> • Mac OS 8.1 or later • PowerPC G3 or G4 processor (233 MHz or faster) • 64 MB RAM and 65 MB virtual memory • 28.8 Kbps modem or faster (56.6 Kbps modem or faster connection recommended) • Speakers • Internet connection and 4.0 web browser • 25 MB free space on your hard disk

Substantial performance enhancement at higher speeds

This course includes video material that can be accessed online using the free RealPlayer from RealNetworks. If you do not already have the RealPlayer installed on your computer, you can download RealPlayer 7 or G2 using the links below. (**Note: You do not need to purchase the RealPlayer Plus**).

Free RealPlayer



Course Documents

[[Top](#)] : [[Powerpoint Files](#)]

Current Location: Powerpoint Files

◀ Back



Introduction (Session 1)

[Introduction](#)

Powerpoint slide show for Wednesday, January 19, 2000.
Topic: Microelectronics products, process flows, driving forces



Introduction (Web Version)

[Introduction\(WebVersion\)](#)



Silicon Production (Session 2)

[Si Production](#)

Powerpoint slide show for Monday, January 24, 2000.
Topic: SG Si production, CZ crystal growth, wafer production



Silicon Production (Web Version)

[SiProduction\(WebVersion\)](#)



CZ Doping (Session 3)

[CZdoping](#)

Powerpoint slide show for Wednesday, January 26, 2000.
Topic: Doping during CZ crystal growth



CZ Doping (Web Version)

[CZ DOPING](#)



Diffusion (Session 4)

[Diffusion](#)

Powerpoint slide show for Monday, January 31, 2000.
Topic: Doping and Diffusion

Document: Done

Powerpoint File

Packaged HTML from Powerpoint

20001CHE598: Semiconductor

Documents

Files):

Silicon Oxidation II (Web Version) - [Silicon Oxidation II](#) (Package Files)

CHE 458/598
Semiconductor
Materials Processing

Silicon Oxidation II

Gregory B. Raupp (ASU)
©2000

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Slide 1 of 54

Powerpoint Slides

- Large simple font
- Clear visuals
- Simple graphics
- Outlines
- Limited information
- Equation editor

SEE next 10 slides

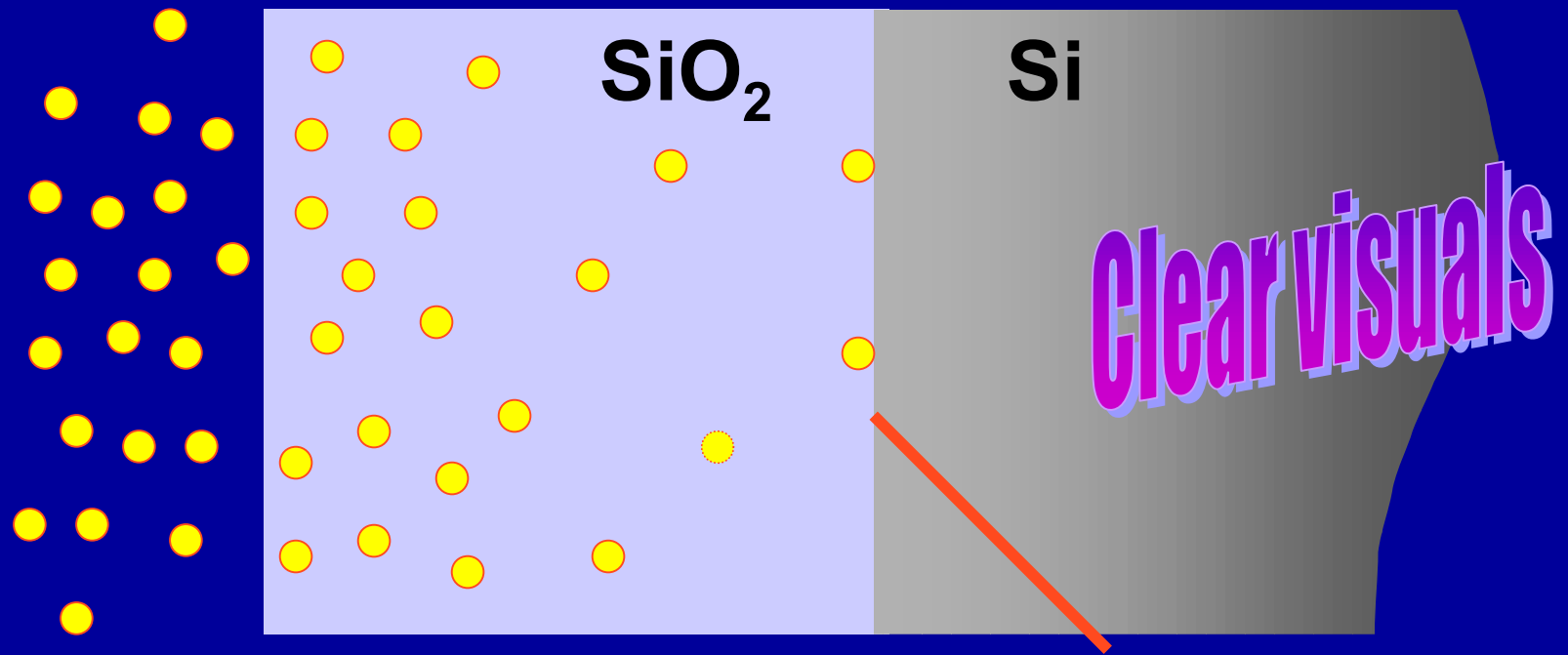
Learning Objectives

Instructor

- Describe and model effects of substrate orientation and dopant concentration in Si thermal oxidation
- Describe and model production of Cl_2 in halogenic thermal oxidation of Si through conventional and point-of-use methods

Large simple font

Molecular processes in D-G model



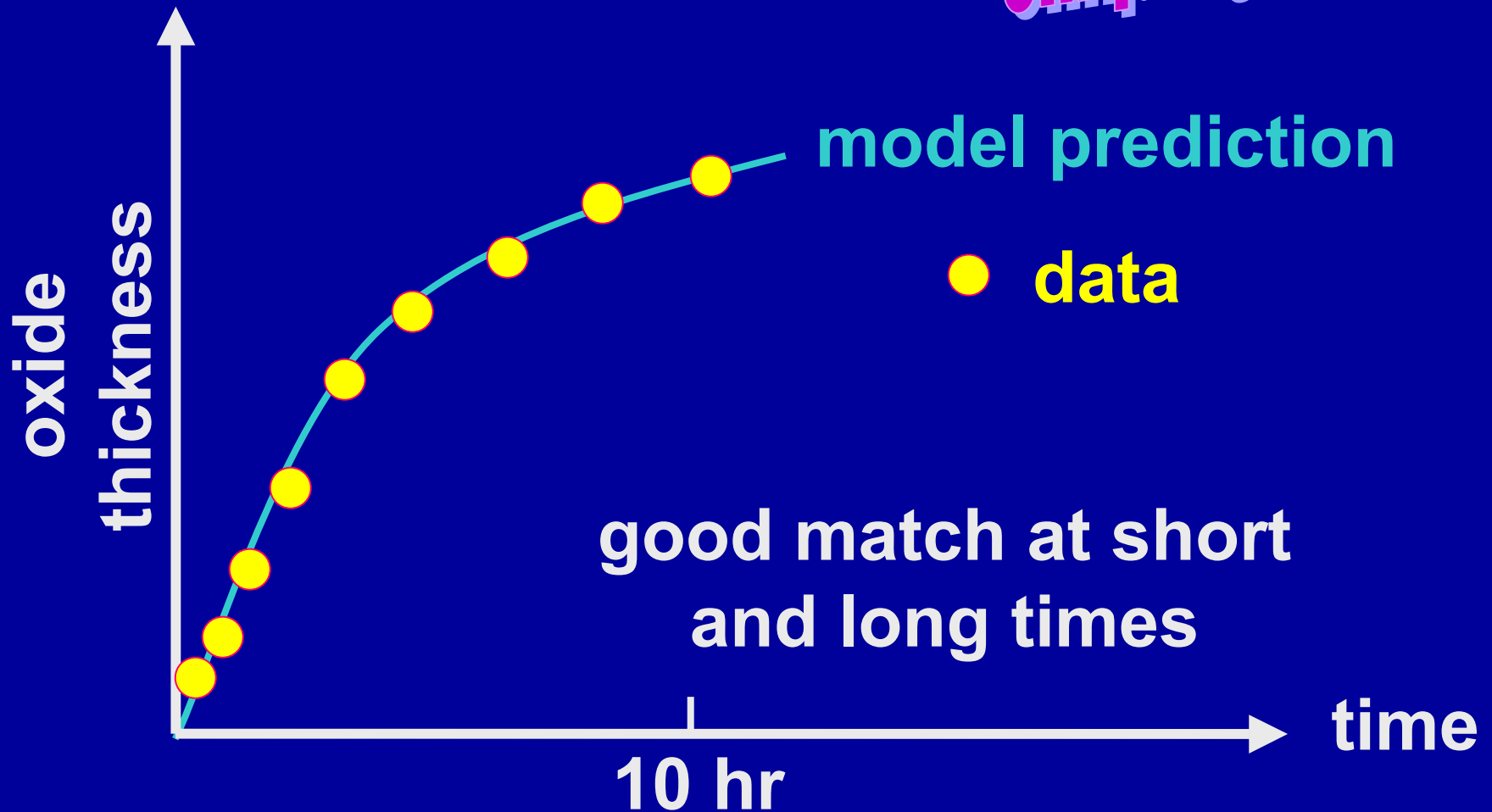
① oxidant
adsorption &
absorption

② oxidant
diffusion
through film

③ reaction at
interface

Model - Experiment comparison: wet ox

Simple graphics



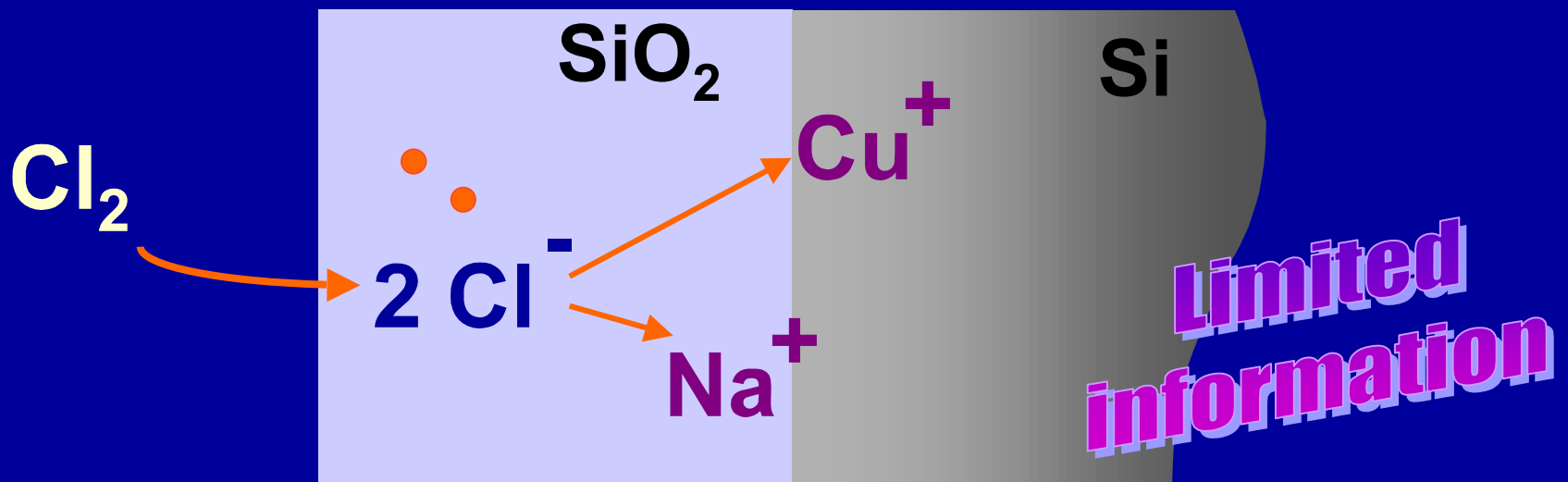
Thermal oxidation in the presence of halogens

- Motivation
- Chemical equilibrium based model for Cl_2 concentration in furnace tube
- Manufacturing and Environment, Safety and Health (ESH) issues and solutions

Outlines

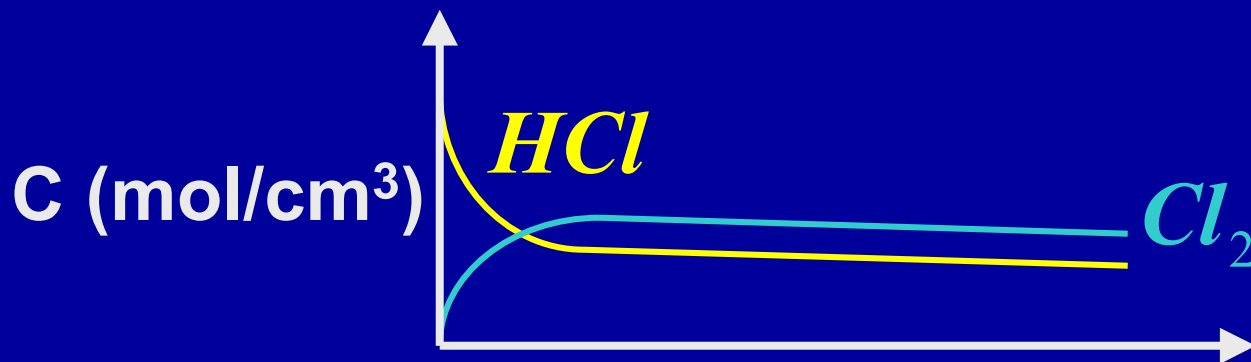
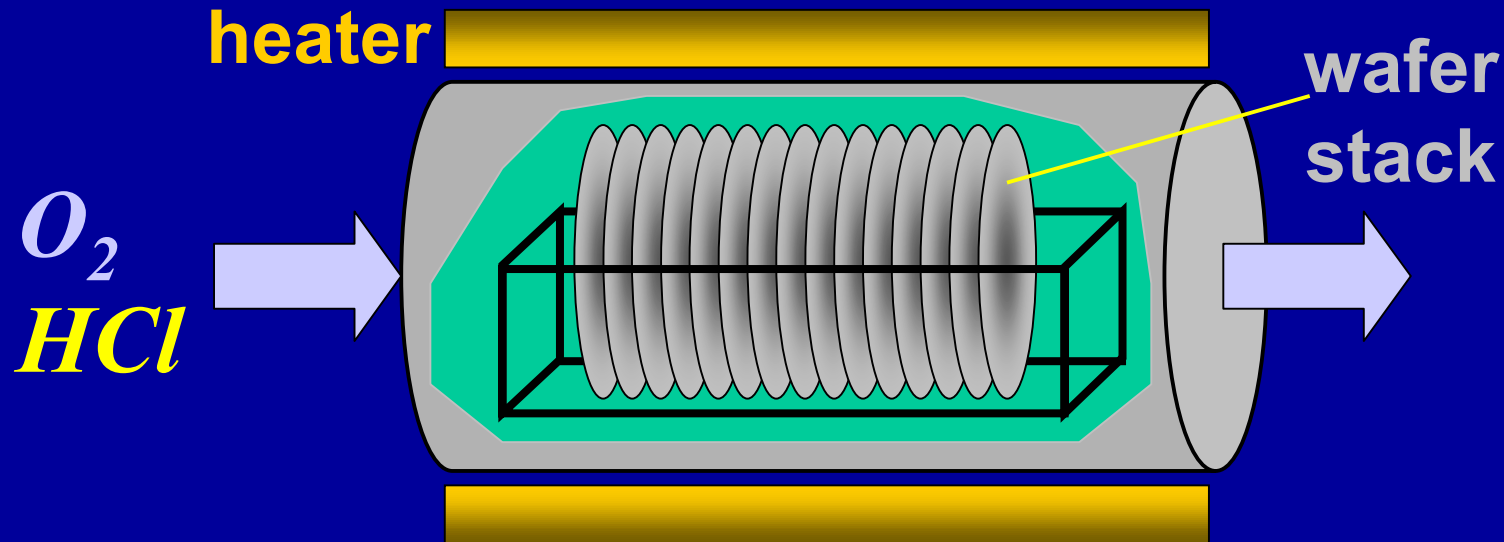
Motivation for halogen use

- enhances dielectric strength: hydroxyl (OH) conversion
- neutralizes impurities



Halogenogenic Thermal Oxidation

Simple schematics



**Chemical equilibrium
constraint: extent
expression simplified**

$$K_p(T) = P^{-1} \cdot \frac{(2\xi)^4 \cdot (20 - \xi)}{(1 - 4\xi)^4 \cdot (19 - \xi)}$$

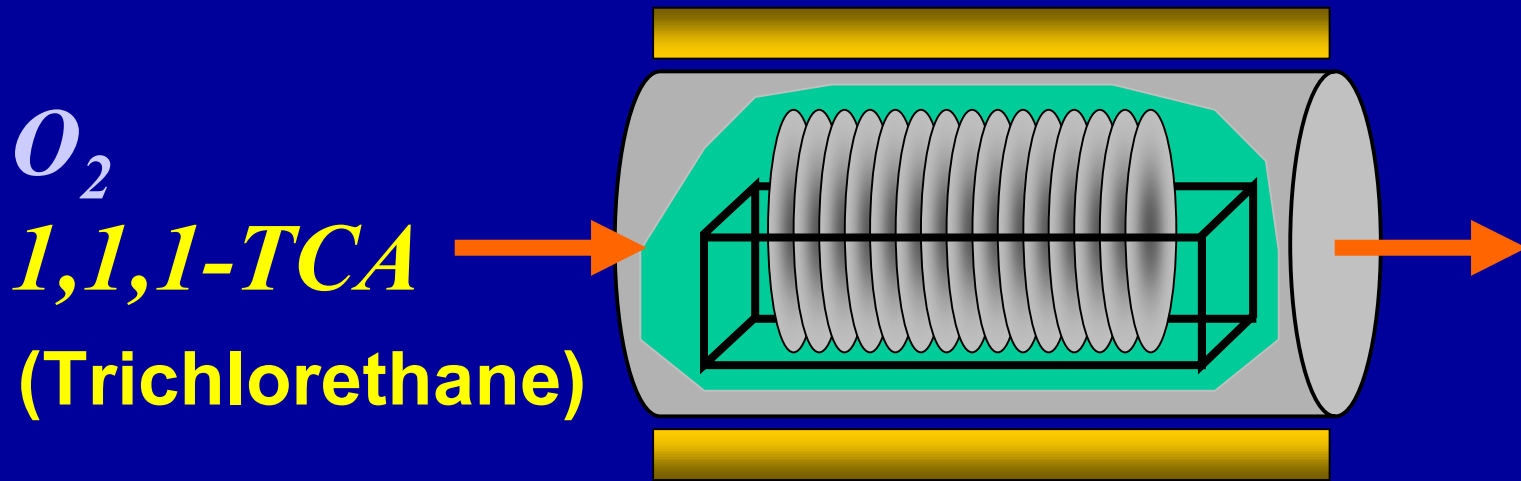
For given T, P
single equation in single unknown:
solve iteratively for ξ

Equation
editor

Concerns with HCI

- ES&H: **Environment, Safety & Health** issue: worker exposure (S&H)
- Manufacturing issue: corrosive to equipment and supply lines (maintenance and reliability)
- Solution: convert process to “**point-of-use**” operation

Point-of-use halogenic thermal oxidation with TCA



fast, irreversible reaction

ES&H concern with 1,1,1-TCA

- **Environmental issue:** TCA extremely stable in atmosphere
- **GWG** - global warming gas
- **Solution:** convert process to “point-of-use” operation with dichloroethylene (*trans-LC*[™])

Remote Student - Instructor Interaction

- **Live instructor call-in**
 - phone number given on Web page
 - audio through the TV or PC, not the phone
- **Threaded Discussion Board**
- **On-line Office Hours (Chat Room)**
- **E-mail**

Threaded Discussion Forums: Admin, Technical, Feedback, Current Events Chat

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Discussion Board

Forum: Technical Forum

VIEW UNREAD MESSAGES EXPAND ALL COLLAPSE ALL
SEARCH

[Show Options](#)

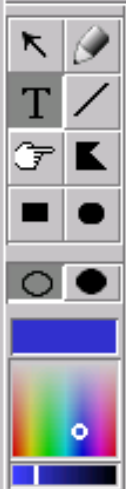
<input type="checkbox"/> assignment 2a - radial boundary condit...	Martin, Edward L.	30-Jan-2000
Re: assignment 2a - radial boundary...	Raupp, Gregory	31-Jan-2000
<input type="checkbox"/> assignment 3b	Thompson, Doug	31-Jan-2000
Re: assignment 3b	Raupp, Gregory	31-Jan-2000
<input type="checkbox"/> Assignment 5	Johnson, Stafford	05-Feb-2000
Re: Assignment 5	Raupp, Gregory	05-Feb-2000
<input type="checkbox"/> Assignment 7	Johnson, Stafford	06-Feb-2000
Re: Assignment 7	Raupp, Gregory	06-Feb-2000
<input type="checkbox"/> Assignment 7b	Pei, Tzer Mei	06-Feb-2000
Re: Assignment 7b	Raupp, Gregory	06-Feb-2000
<input type="checkbox"/> Assignment #9	Pei, Tzer Mei	13-Feb-2000
<input type="checkbox"/> Re: Assignment #9	Raupp, Gregory	13-Feb-2000
<input type="checkbox"/> Re: Assignment #9	Wajida, Erin	13-Feb-2000
Re: Assignment #9	Raupp, Gregory	15-Feb-2000

[[Click Here for Archives](#)]

Sort By:

[◀ Back to Forum View](#)

Location:



Whiteboard to facilitate ...

Participant info

Slide navigation

Access control



TutorNet

Questions & Answers

use the box on the right to submit questions to the instructor.

Request Private

Assignment Submission

- **hard copy (couriers)**
- **fax copy**
- **soft copy: Web-site dropbox**
 - **Office 97 (Word, Powerpoint, Excel)**
 - **Mathcad 6.0 Plus**
 - **Matlab 5.0**
 - **scanned image files**

Key concern: Student-Instructor Connection

- **Show your human side**
- **Use ice-breakers**
- **Try limited interactive exercises**
- **Be responsive -- especially early in the course**
- **Student pages**

Overall Performance S99

Grade	Studio	TV	Web
A	11	4	5
B	8	-	-
C	5	-	-
XE	2	-	-
W	3	-	2

Feedback from Students I

Chat room
beneficial

Instructor
response time
good

Strongly disagree

Disagree

Neutral

Agree

Strongly agree

Sufficient opportunity
to interact with other
students

Discussion board
beneficial

Feedback from Students II

- Most positive aspect: availability of archived lectures
- Most common complaint: low quality of Webcast, net congestion, unstable connections
- Course content and difficulty, workload level met expectations