# *157nm University Resist Research Project*

(09-12-01)

Will Conley-Motorola Assignee
Danny Miller-International SEMATECH
Paul Zimmerman-Intel Assignee

# Welcome to Paul Zimmerman; Intel Assignee


INTERNATIONAL SEMATECH

CLEMSON

Cal

CORNELL UNIVERSITY

CALIFORNIA INSTITUTE OF TECHNOLOGY 1891

# 157nm University Resist Research Project Team

## SEMATECH

- Will Conley
- Jeff Byers
- Dan Miller
- Georgia Rich
- Vicki Graffenberg
- Shashi Patel

## UT

- **Prof Grant Willson**
- Matt Pinnow
- Raymond Hung
- Brian Osborne
- Shintaro Yamada
- Tony Van Hayden
- Hoang Vi Tran
- Brian Trinque
- Jordan Owens
- Vincent ????

## Cal-Tech

- **Prof Grubbs**
- Dan Sanders

## UC-Berkeley

- **Prof Jean Frechet**
- John Klopp
- Nick Benzal

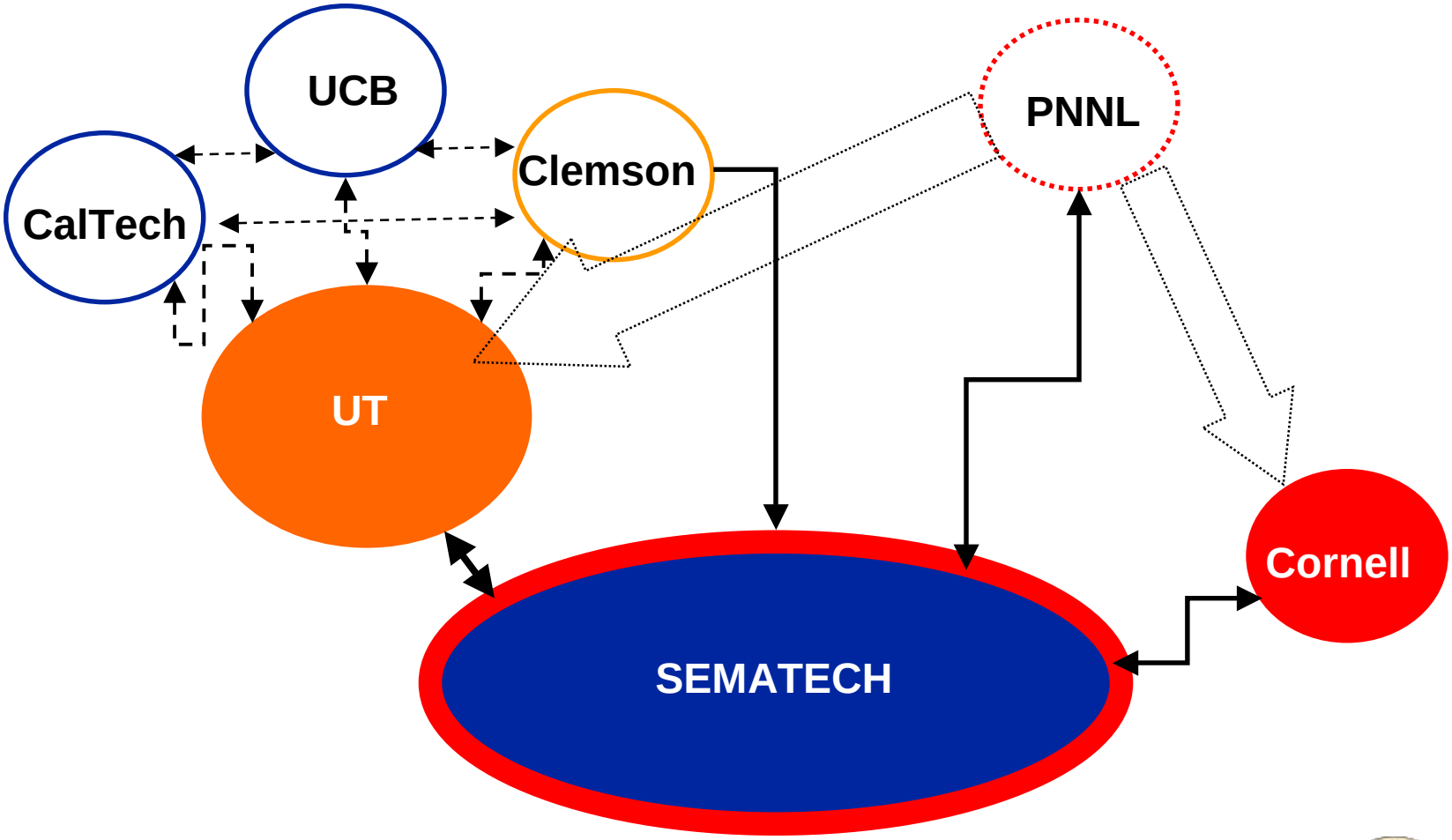
## Clemson

- **Prof Darryl DesMarteau**
- Brian Thomas
- Greg Shafer

## Cornell University

- **Prof Chris Ober**

# 157nm University Resist Research Project Team



# SEMATECH Sept 2001 RAG-Presentation Agenda

SEMATECH
- Will Conley

Clemson
- Brian Thomas- $C_2F_4$

Cornell
- V. Vora - Acrylate Platforms

Berkeley
- Nick Benzal- Mass Persistence

The University of Texas
- Brian Osborn – ROMP and Metal catalyzed addition polymers
- Charles Chambers – Free radical polymerization
- Brian Trinque – Acrylate copolymer based resists
- Takashi Ciba – CO co-polymers and dissolution inhibitors
- Will Conley – Process studies

Summary and Questions

## 3.1 Performance Targets for 157 nm Resist Systems

| Ref. | Parameter | Development Specs | Manufacturing Specs |
|---|---|---|---|
| 3.2.1 | Photospeed | 15 mJ/cm$^2$ @157 nm | 10 mJ/cm$^2$ @157 nm |
| 3.2.2 | Ultimate Resolution<br>1:1 Pitch<br>1:1.5 Pitch<br>Isolated Lines | 0.60 NA tool @157 nm<br>120 nm<br>100nm<br>90nm | 0.60 NA tool @157 nm<br>100 nm<br>90nm<br>70nm |
| 3.2.3 | Image Stability | 30 minutes | 1 hour |
| 3.2.4 | Exposure Latitude | ±8% | ±10% |
| 3.2.5 | Focus Latitude | ±0.175 µm | ±0.175 µm |
| 3.2.6 | Isolated-to-Group Bias | 10% | 5% |
| 3.2.7 | Linear Resolution<br>1:1 Pitch<br>1:1.5 Pitch<br>Isolated Lines | 0.60 NA tool @157 nm<br>120 nm<br>110nm<br>100nm | 0.60 NA tool @157 nm<br>110 nm<br>100nm<br>80nm |
| 3.2.8 | Sidewall Slope | 86 -92 | 87 -90° (no foot or cap) |
| 3.2.9 | Thermal Stability | 2 min @ 130C | same as Development |
| 3.2.10 | Post-Exposure Bake (PEB) Time | < 90 sec | same as Development |
| 3.1.11 | Etch Resistance | Feasibility for 1000A poly etch | 20% resist remaining after 1000A poly etch |
| 3.1.12 | Line Edge Roughness | 2% (1 σ) | 1% (1 σ) |
| 3.1.13 | Contact Holes | 130nm 1:1 Pitch | 120nm 1:1 Pitch |

**** Transmission accounted for in resist thickness requirements**

# LITJ102: University 157nm Resist and Process Research

**Objectives:**

- Gain fundamental understanding of physics and chemistry of 157nm resists
- Develop model resist platforms for 157nm resist.
- Demonstrate performance for 70 and 100nm technology generations

**Benefits:**

- Open resist platforms available to worldwide suppliers
- Early learning from a model resist platform
- Leadership position relative to new developments

**Approach:**

- Build on the successes of the 193nm project
- Team with other university researchers
- Team with resist suppliers and researchers from around the world

**Deliverables**

- Resist samples every four months to progressively tighter performance criteria
- Yearly Materials Progress Checkpoints
- Material Transparency Report 2Q00
- Zero-diffusion resist by 2Q01
- Zero-outgassing resist by 4Q01
- Final project report 4Q02

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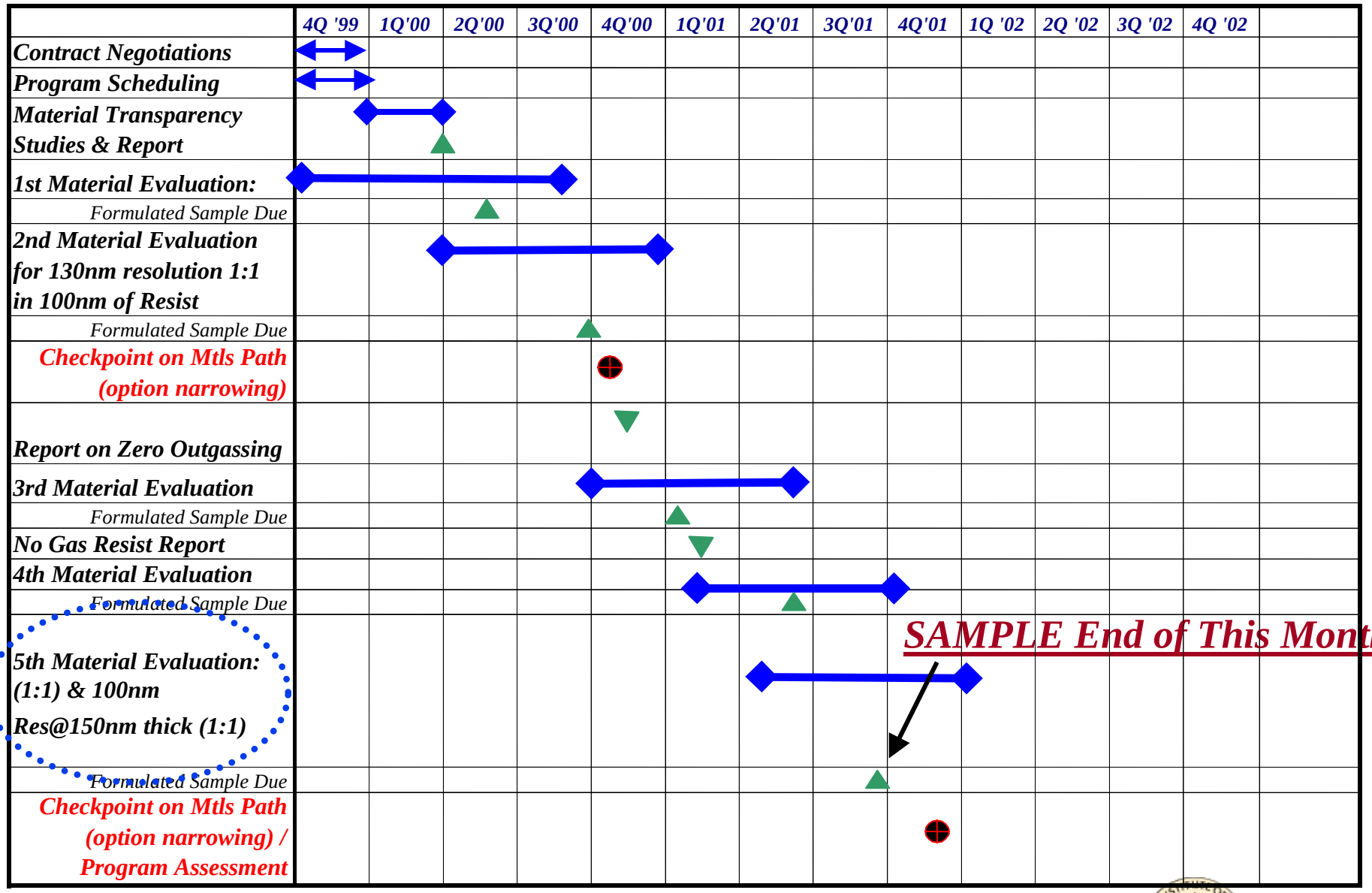
# SEMATECH-UT 157nm Materials Research Program Schedule-Overview

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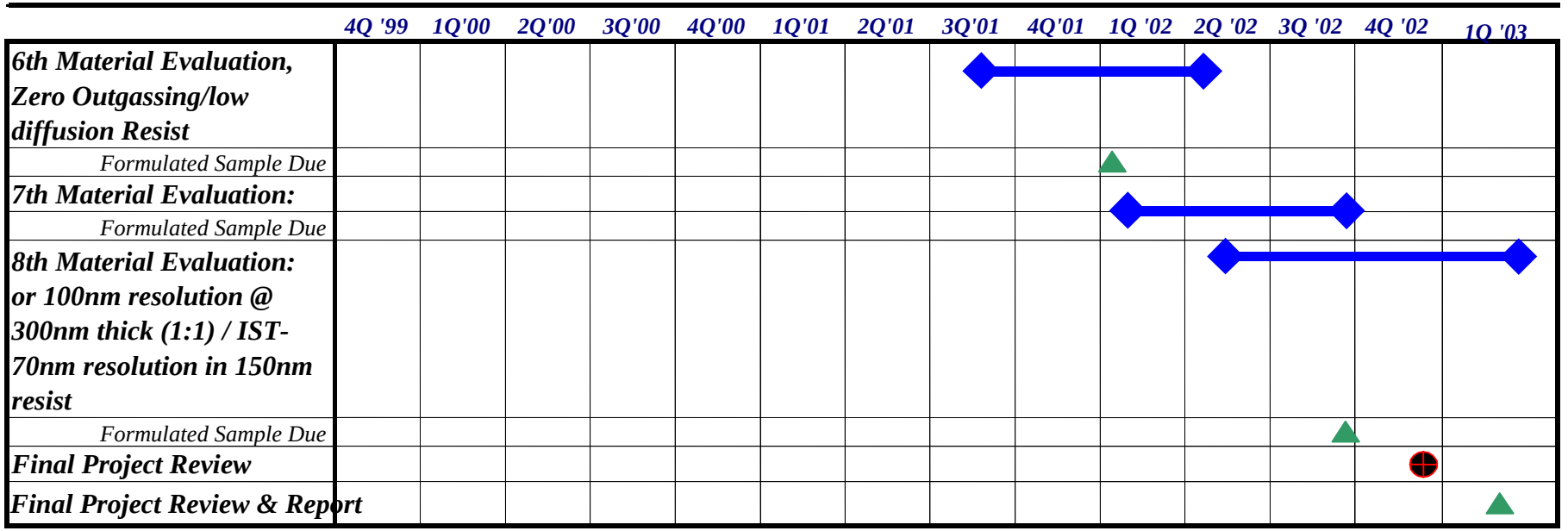


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## ***This Reporting Period***

- New DI's
- Free Radical Polymerizations
- More transparency
- Transparency requirements
- Imaging & processing data

## ***Due this month***

5th Sample

- 100nm 1:1 in 150nm of Photoresist

# ***Cornell Contract Extension***

- Statement of Work extended
- First year summary meeting in early October with report to follow
- Contract extension signed by Cornell and ISMT
- 2 additional researchers added to staff
- No research interruption

# ***Clemson Contract Extension***

- Statement of Work extended & at Clemson
- First year summary meeting in early October with report to follow
- 1 additional grad student added to project
- No research interruption

# Pacific Northwest National Labs (PNNL)

- People
  - Dave Dixon, Associate Director for Theory, Modeling & Simulation
  - 5 yrs at PNNL
    - Computational aspects of fluorine chemistry
  - 12 years Dupont
    - Calculation thermochemical & kinetic properties of alternatives for CFC's.
  - Chang-Guo Zhan, visiting scientist from Columbia University, Ph.Ds in chemistry and physics

- Mission: Establish a program of research in computational molecular science, combining the elements of theoretical and computational chemistry, and materials science with computer science, applied mathematics, and advanced computing technologies, to provide a molecular level understanding of complex processes in various environments.

- Recent work with with EUV, recent work with SELETE on $F_2$
- Focus of this work is to further develop model capability to support Universities and Resist Companies in the accurate prediction of spectra.

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# Pacific Northwest National Labs (PNNL)

- Progress and Plans
  - Contract signed in late August
  - Kick-off meeting held and milestones discussed
  - Progress report  to the next RAG will be made by David Dixon/Chang-Guo Zhan
  - Scheduled FTF in late October or early November