

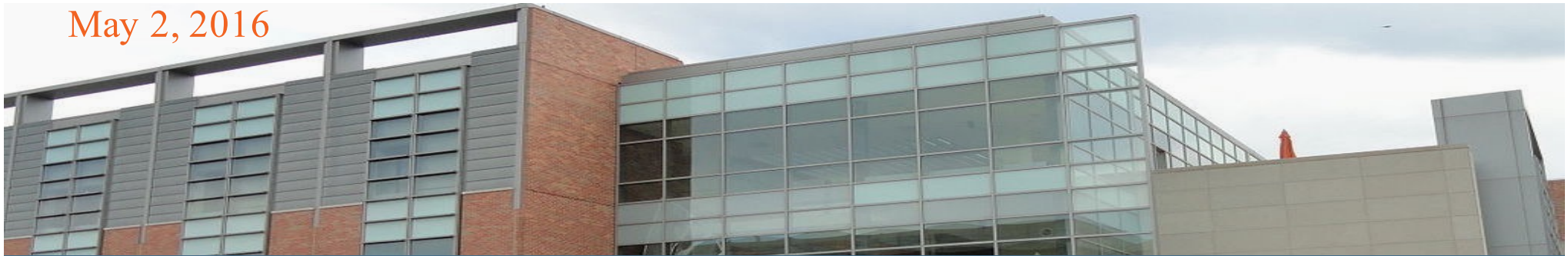
T2C2

NSF DIBBs T2-C2 Project and 4Ceed Tool

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Coordinated Science Laboratory, University of Illinois at Urbana-Champaign

May 2, 2016



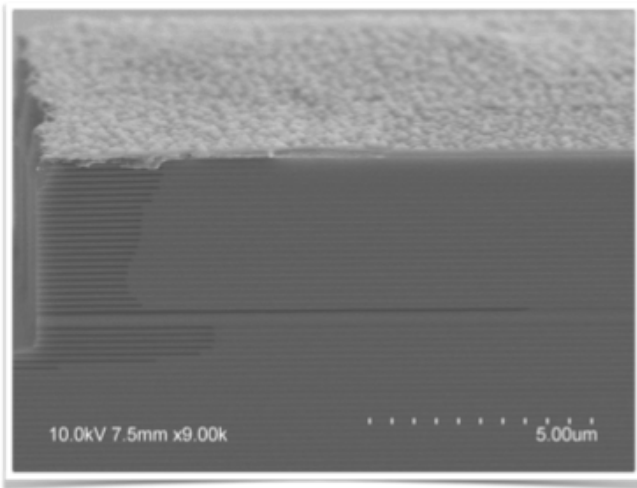
A timely and trusted curator and coordinator of scientific data

The environment, the team

- An academic institution, first and foremost
 - New researchers every year that need to be trained
 - ... and they leave on a regular basis (we hope!)
 - Every experiment every hour is likely to be different
 - ... where what was done before could be crucial to what is done next
 - Limiting costs is at a premium
 - ... most won't have manufacturers' data tools; images are extracted as **tif** files with loss of metadata
- An interdisciplinary team led by the three IRUs from the College of Engineering
 - Expertise in IT, cybersecurity, material science, device fabrication
 - Working together for the first time and doing very well

Collected Data

An example of the result from an experiment at MNTL



Result image of 07302013-Oxidation experiment

Experimental setting:

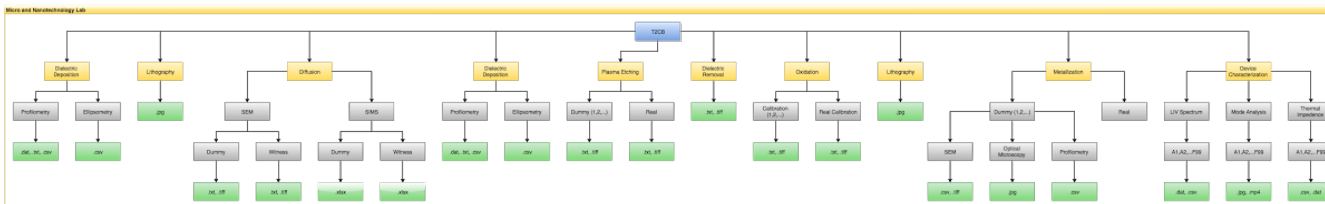
Time 13min
Temp 425 C

(Structured meta data)

Notes:

Oxidation depth is about 12um.
Oxidation layer composed of Al(0.98)GaAs with thickness of 30 nm. Furnace in 2111 MNT L, 2" diameter quartz.

(Free text)



- COLLECTION
- DATASET
- FOLDER
- FILES

Current State of Data Capture in Materials and Semiconductor Domains

- Current situation for experimental data involves manual processes for data capture and storage leading to **poor documentation of results**



- Data transfer is often done via “sneaker-net” techniques using flash-drives or email
- No data file conversion is available

- **“Best” results and images are kept**, but what is “best” is determined by a narrow, specific scientific objective. **“Imperfect” data is often discarded** or not available for others to review.



Proposed Solution

4CeeD: Timely and Trusted Capture, Curation, Correlation, Coordination and Distribution

- Timely: Data is collected immediately upon collection
- Trusted: Data is stored so that only those permitted users can see it
- Capture: Data is captured in real-time from microscopes
- Curation: Data is permanently tagged for future usage
- Correlation: Data dependencies are captured
- Coordination: Data of many different types is handled, filtered and classified for easy access and search
- Distribution: Data is disseminated among scientific instruments, clouds and users

4CeeD Curator

Aaron Schwartz-Duval

[FAQ](#) [Logout](#)

01 Choose a collection... what's this?

Existing collections

Right click a collection to create a sub-collection.

- 2016_01_12_Au-PEG_cell
- Au-shelled micelles
- D130-SingleModeVCSEL
- D140-SingleModeVCSEL
- D141-SingleModeVCSEL
- D143-ZnDiffusionMask
- D20-SingleModeVCSEL
- D200-ZnDiffusion_InP
- Dc1-OxidationCalibration
- In situ project
- In vitro growth
- Zinc Diffusion Calibration
- polyvilli
- root

New Root Collection

02 Choose a dataset... what's this?

Existing Datasets

New Dataset

Basic Load Custom

Load a template Clear

Choose a dataset template:
polyvillic nanoparticles

Choose a name for your dataset:
Example... Sample Name, PECVD Oxide, Diffusion

Add

Name: Value: Remove

Name: Value: Remove

Incubation1 time (min) : Value: Remove

Create Dataset

03 Click browse or drag and drop files..

Browse Drag & Drop Files

3). 2015_06_19_10-50_24-RT_0003.dm3 (16.58 MB)
File Comments:
Cancel

2). 2015_06_19_10-50_24-RT_0002.dm3 (16.58 MB)
File Comments:
Cancel

1). 2015_06_19_10-50_24-RT_0001.dm3 (16.58 MB)
File Comments:
Cancel

Submit

Create or Select A Collection

Create or Select Dataset

Upload Files

Optional: Choose template and enter metadata

071315-ZnDiffusion

Created by [Phuong Nguyen](#)

Created on Mar 06, 2016

All Rights Reserved Phuong Nguyen

Furnace calibrated for this sample and all further. Tube is 6.24in long and rod 2in shorter than before to avoid previous condensation issue.

Proper disordering found to be 0.72um with zinc presence up to 1um+ deep. Will confirm with SIMS but disordering shows blurred interfaces indicated goal achieved.

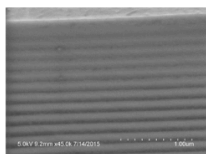
[+ Add Files](#) [Download All Files](#) [Delete](#) [★ Follow](#) [Publish](#) [✓ Create Folder](#)

Files

Metadata

Visualizations

Comments (0)

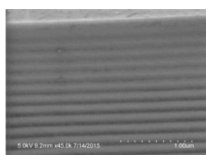


PostDiff.TIF

image/tiff

Mar 06, 2016

📄 0 🗂️ 0 💬 0 🗑️

[Download](#)[★ Follow](#)

PostDiff_raw.tif

image/tiff

Mar 06, 2016

📄 0 🗂️ 0 💬 0 🗑️

[Download](#)[★ Follow](#)

Spaces containing the dataset

Select a space

[+ Add](#)

Collections containing the dataset



SEM

12 datasets | [✖ Remove](#)

Select a collection

[+ Add](#)

Tags

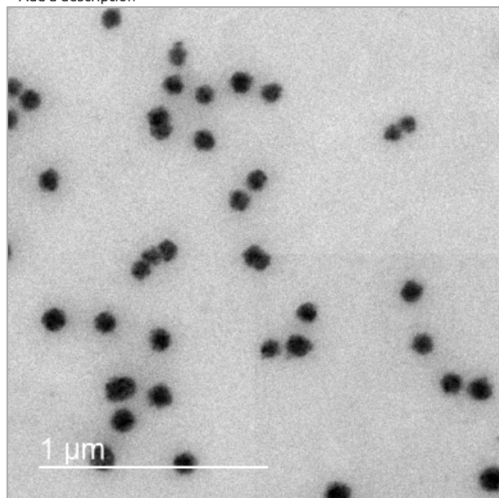
[Tag](#) Show tags on files in this dataset



2016_04_14_Gd-filled micelle_0008.dm3

in 2016_04_14 Gd filled micelles

Add a description



Download

Follow

Delete

Metadata



Add metadata

Select field

— Extracted by <http://clowder.ncsa.illinois.edu/extractors/deprecatedapi> on Apr 18, 2016

Acquisition Parameters Objects 1 Version: 33947648
ImageDisplayInfo Gamma: 0.5
ImageDisplayInfo CLUTName: Greyscale
Microscope Info Indicated Magnification: 10000.0
Acquisition Parameters Detector frame sequence sections 0 segments 3
parameters par read: 1040
Acquisition Parameters High Level Shutter Pre Exposure Compensation (s): 0.0
Acquisition Parameters High Level Shutter Shutter Index: 0
Name: 2016_04_14_Gd-filled micelle_0008
PageSetup Win32_DevNamesW Size: 100
Acquisition Parameters Detector frame sequence sections 0 segments 0
parameters ser clr: 1120
Acquisition Frame Intensity Range Dark Current (counts/s): 0.0

Type: image/digitalmicrograph
File size: 16 MB
SHA 512: ...9515cf963d [copy](#)
Uploaded on: Apr 18, 2016 03:35:47
Uploaded by: [Aaron Schwartz-Duval](#)

License

Type: All Rights Reserved
Holder: Aaron Schwartz-Duval
[Edit](#)

Tags

Learning from past users “failures”

Discovery

- *“What is the thickness of Oxidation layer if I set temperature at 500C for 20min?”*
- *“Find all the experiments that produce Oxidation layer below 20nm”*

Error/failure analysis

- *“What are the common reasons for failed oxidation experiment?”*

Faceted Search



4CeeD

Spaces

Datasets

Collections

Users

Search

Search



Type

10

a-z ↓

OR

DiffMask (3)

Etch (1)

MesaEtch (5)

MesaMask (1)

SiO2Deposition (1)

ZnDiff (10)

Time

less than 15min (11)

45min - 1hour (5)

1hour+ (5)

Sample

10

a-z ↓

OR

D140-EW850#1 (3)

Test 2 (1)

Test 3 (1)



8



order by ... relevance



Name



*



1 – 8 of 22



3 DiffMaskEtch SF6

Tool: Oxford ICP Recipe: Dallesasse SF6 Pressure: 10mT Temp: 20C Time: 42s RF: 50W ICP: 0W SF6: 20sccm Pressure (Helium): 20

022515 MesaEtch 4 F

Notes: Alpha Step Height (remaining nitride mask + GaAs) - 8.62 um

4 ZnDiff DBRtest1 OM

T: 610C set with N2 flow rate at 1:15 t: 50min Tool: Dry Furnace MNTL 2111

4 ZnDiff DBRtest1 SEM

T: 610C set with N2 flow rate at 1:15 t: 50min Tool: Dry Furnace MNTL 2111

070515 ZnDiffusion

Furnace calibrated for this sample and all further. Tube is 6.24in long and rod 2in shorter than before to avoid previous condensation issue. Sample used is Epiworks 850nm VCSEL DBR calibration. Proper disordering for ~400nm. Zn appears for 1.1um depth.

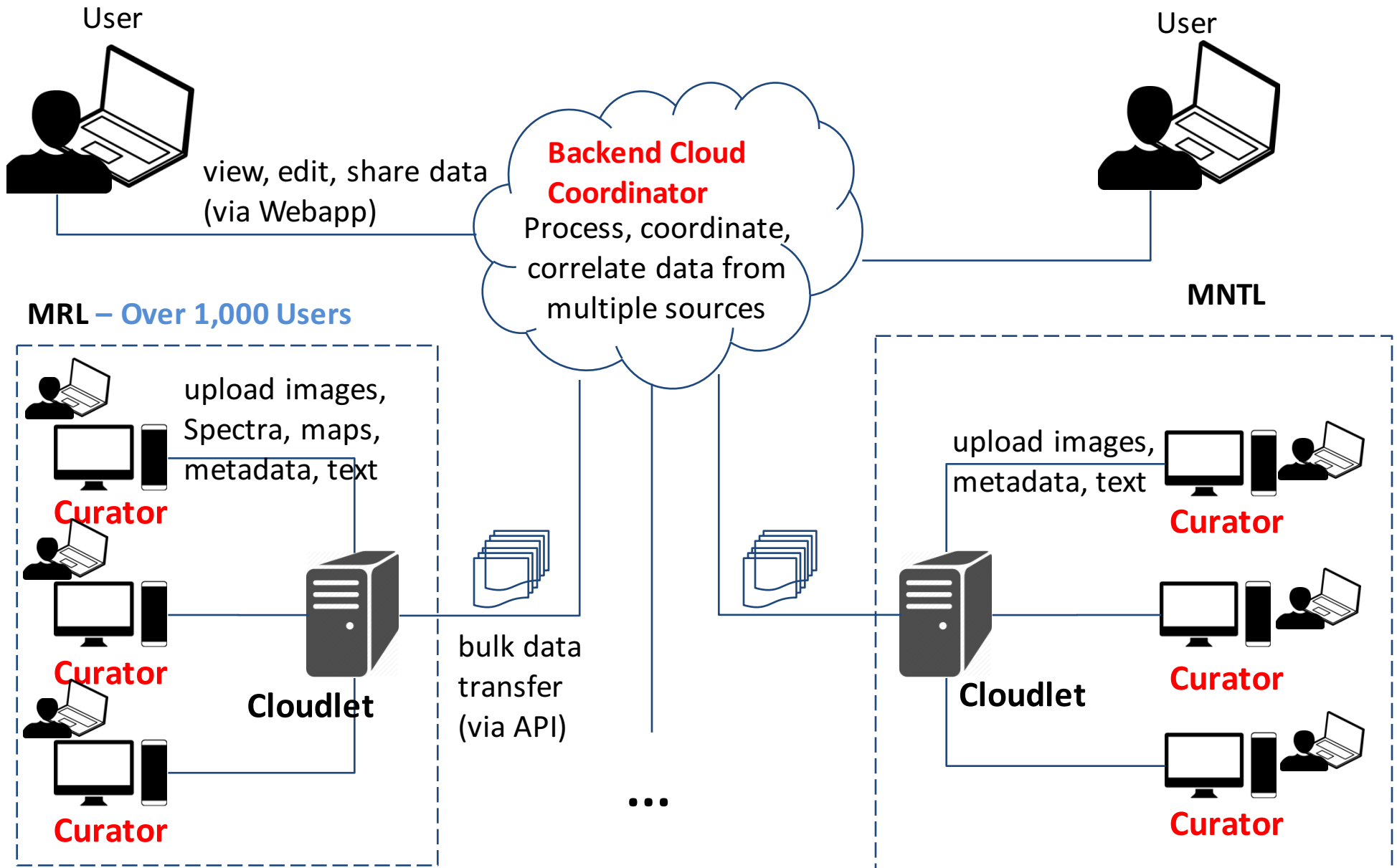
030315 MesaEtch 1 F

Notes: Blinked 5 times before stable plasma Alpha Step Height (remaining nitride mask + GaAs) - 2.74 um

070715 ZnDiffusion

Furnace calibrated for this sample and all further. Tube is 6.24in long and rod 2in shorter than before to avoid previous condensation issue. Sample used is Epiworks 850nm VCSEL DBR calibration. Proper disordering for ~12 pairs of DBR.

Our Approach: 4Ceed Design – Component View



4CeeD key features and anticipated benefits

- **What does 4CeeD curator do that nothing else does?**
 - REAL TIME curation of metadata.
 - Metadata Extractors for SEM and proprietary TEM instruments.
 - Clean simple to follow layout and process.
 - Supports complex data models.
 - Uses global and custom templates to maintain accuracy and speed up user defined metadata entry.
 - No data is lost. Support for log, image, and user metadata into single download.
- Time savings (lost time at an expensive machine, lost time for user, better accuracy)
 - Users **can save upwards of 20-30 minutes per lab session**. This can add up to a significant time and money savings over the life of an experiment, with some experiments taking 40-60 hours over 2 months.