

Willkommen  
Welcome  
Bienvenue



# OpenBIS @ Lab 207

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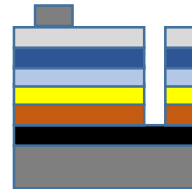
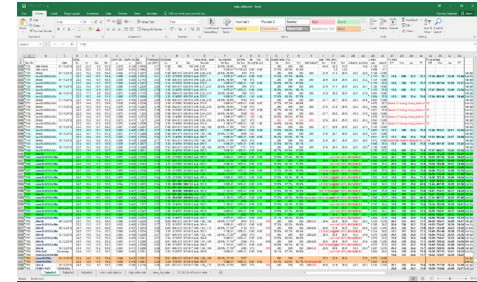
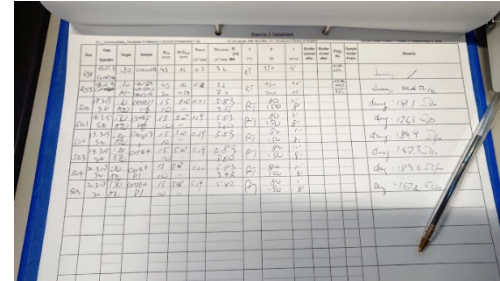
207 – Thin Films and Photovoltaics

# Outlook

- Motivations
- Lab workflow
- OpenBIS, data organization
- Implementation phases
- Plans for the next months
- Assessment

# Motivations

- Help lab people !
  - Keep track
  - Structure activity
  - Cross-samples analysis
- New capabilities
  - "Curated" data & meta-data
  - Data sharing
  - Scriptable data retrieval  
Basis for statistics, DM, ML, AI etc.
- Challenges
  - Paper logs
  - User-specific, incomplete databases
  - Team work!
  - Data storage modalities
  - Personnel turnover

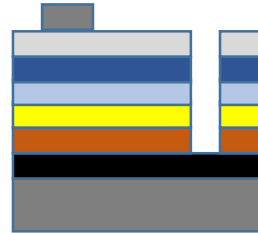


Data is on G:\ ... !?

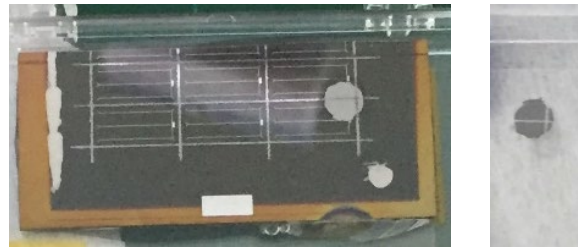
# Lab workflow

## Workflows

- Non-trivial
- Non-standard
- Wide variety  
Solar cells, batteries, printed electronics...



➔ Generic manner to handle experimental steps



CIGS solar cells, 5x2.5 cm<sup>2</sup>

## Possible sample workflow:

process characterization

- Substrate cleaning
- Sputtering SiO<sub>x</sub> + Mo
- coevaporation CIGS
- XRF
- Rinsing + CBD
- Drying (vacuum)
- Sputtering ZnO + ZnO:Al
- Evaporation Ni + Al
- Evaporation MgF<sub>2</sub>
- Scribing
- Scan
- JV
- Data correction
- EQE
- Cut in 2 parts
- C-V, C-f
- SIMS
- Send part to partner
- Heat-light treatment
- JV (2)
- Data correction

## Key features

- Flexible system configuration
- Data access
  - user interface
  - script: python
- Separation shared / private
  - Private: ~laboratory notebook
  - Shared: process, samples, etc.  
→ **our focus**

## To take into account...

- **Complex lab activity**
  - Process sequences/recipes: multiple, variable
  - Sample history does matter
- User acceptance
  - **Usefulness vs daily effort**
  - Critical: time-efficient data input
- **Data consistency & quality**
  - Strongly formatted data input
  - Flexibility: links sample  $\leftrightarrow$  process

# Data organization: digital twin

## Laboratory

### Substrate

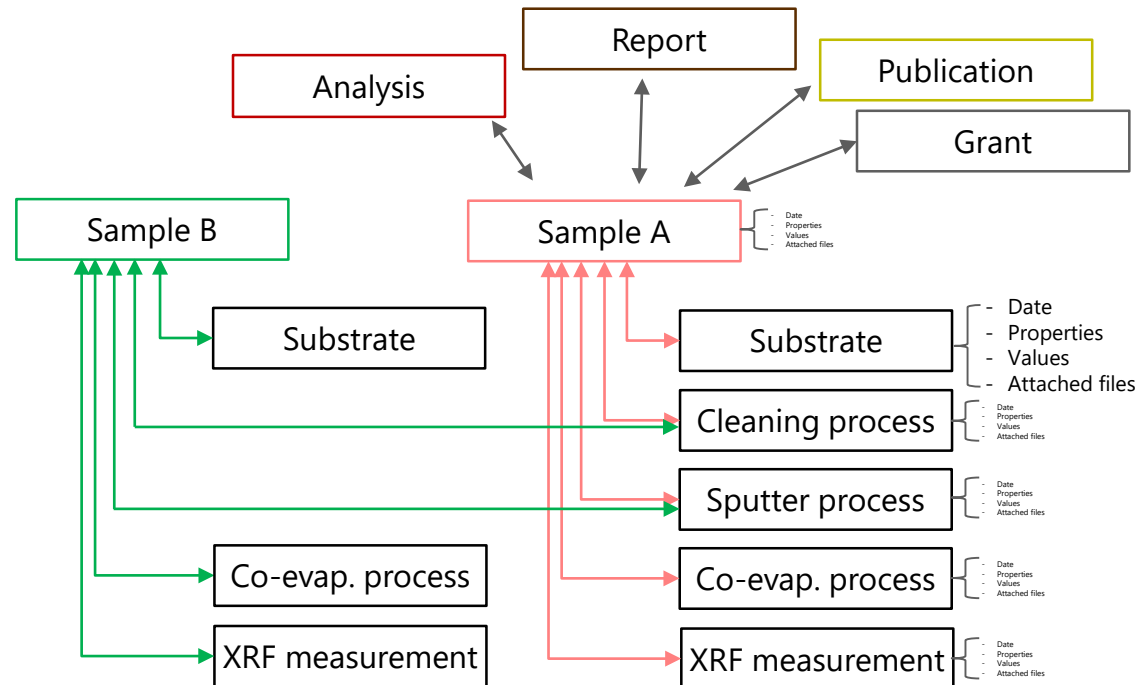
1. Cleaning (time, solvents, etc.)
2. Sputtering (recipes, logs, param...)
3. Co-evaporation (recipe, ...)
4. XRF (data, metadata, results...)
5. ...

## Access to

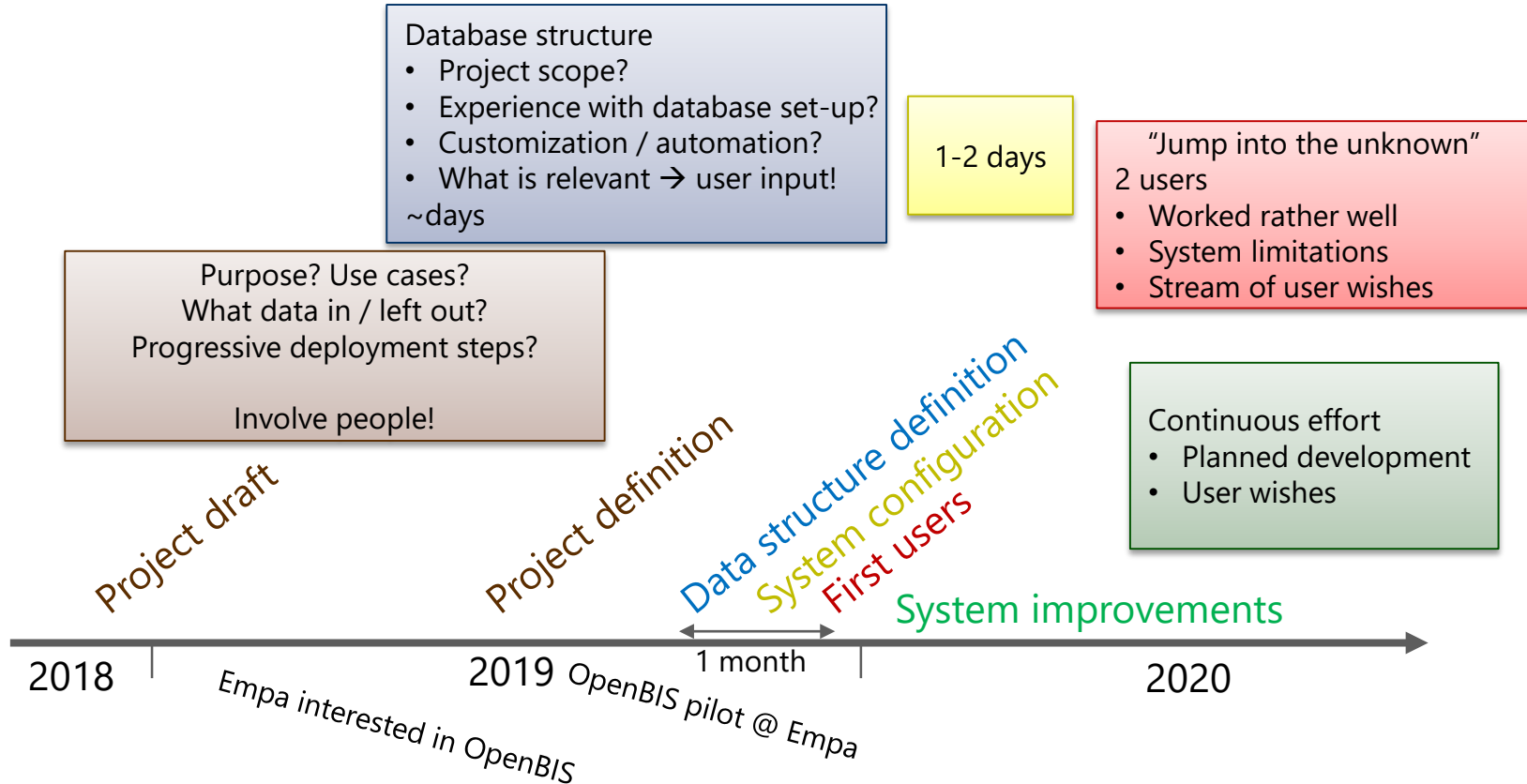
- Equipment e-logbook
- Sample history
- User activity
- Easy data retrieval (UI, API)

## Database

- Samples, processes as independent “objects”
- Links as information

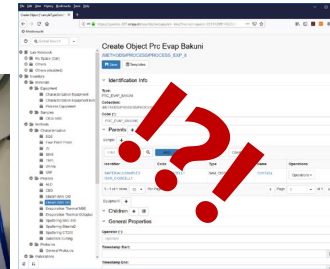
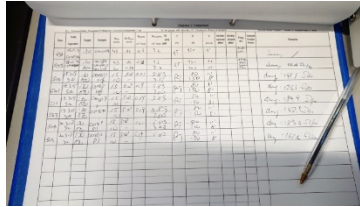


# Implementation timeline Abt 207



# Plans for the next months

- Web forms for data input



**Web interface**  
Processed server-side  
Server by IT  
Software by 207

Quick?	Fast <30s	Slow	Fast
Brain load	Low	High	Low
Real-time	Yes	done later	Yes
Standardized	No	?	Yes + preprocess
Data access	Difficult	Good	Good

- Barcodes
  - User roll-in
    - New lab members      workflow on openBIS
    - Other lab members    only specific processes
- Migration: ~3 years



# Assessment and open questions

- Seems to work!
  - Feasible effort
  - Goal & scope to clearly define  
Discussion with other users helped
  - Long term project...
  
- Limitations
  - Software: interfaces are critical
  - Time-effectiveness
  - Access rights
  
- Community of admins/users @ Empa ?
- Data Management Plan ?

## Our status

- ✓ Database functional
- ✓ Handles complex lab activity
- Usefulness vs. daily effort
- Data consistency & quality



■ Time for questions?

File Edit View History Bookmarks Tools Help

Object SAM\_CIGSCCELL25

https://openbis-207.empa.ch/openbis/webapp/eln-lims/?menuUniqueId=20191120133349708-53&viewName=showView

Meistbesucht

Global Search

Lab Notebook

- My Space (Car)
- Others
- Others (disabled)

Inventory

- Materials
  - Equipment
    - Characterization Equipment
    - Characterization Equipment External
    - Process Equipment
  - Samples
    - CIGS cells**
- Methods
  - Characterization
    - EQE
    - Four Point Probe
    - JV
    - SMS
    - TRPL
    - UV-Vis
    - XRF
  - Process
    - ALD
    - CBD
    - Ebeam BAK Old
    - Ebeam BAK Uni
    - Evaporation Thermal MBE
    - Evaporation Thermal Octopus
    - Sputtering BAS 450
    - Sputtering Plasma2
    - Sputtering CT200
    - Substrate Cutting
  - Protocols
    - General Protocols
- Publications
  - Public Repositories
  - Publications Collection
- Stock
  - Stock Catalog
  - Stock Orders
- Utilities
  - User Profile
  - Barcodes Generator
  - Object Browser
  - Vocabulary Browser
  - Advanced Search
  - Exports
  - Storage Manager

Object: Oct1763a

/MATERIALS/SAMPLES/SAM\_CIGSCCELL/SAM\_CIGSCCELL25

Parents

Filter AND OR Options Columns

Code	Name	Modification Date
EQP_FRC10	Glass Cutter	2020-02-17 11:50:28
SAM_CIGSCCELL24	Oct1763	2020-01-23 16:58:49

1 - 2 of 2 items 10 Per Page Page 1 of 1

Processes and Characterization

Filter AND OR Options Columns

Code	Process Type (Recipe)	Short process description	Timestamp Start
PRC_ALD12		TMA + Zn5Mg10 C=50 at T=120deg Plasma	2020-01-23 08:30:00 +0100
PRC_SPUT_BLASMA7		±ZnO, 80W, 660s, ~70nm	2020-01-24 08:00:00 +0100
PRC_SPUT_BLASMA8		ZnO-AL, 200W, 460sec, ~200nm	2020-01-24 08:30:00 +0100
PRC_EVAP_BAKJUN4	Ni-Al Grid	Grid: 500nm Ni + 4000nm Al	2020-01-24 12:30:00 +0100
CHR_SOL_JV6		JV: AM 1.5 + 2minLS	2020-01-27 08:00:00 +0100
CHR_SOL_EQE6		EQE	2020-01-27 11:00:00 +0100

1 - 6 of 6 items 10 Per Page Page 1 of 1

General Properties

Name: Oct1763a

Owner: hera

Sample Exists?: true

Identification Info

Type: SAM\_CIGSCCELL

Collection: /MATERIALS/SAMPLES/SAM\_CIGSCCELL

Code: SAM\_CIGSCCELL25

Registrar: hera

Registration Date:

Select a dataset type

Files Uploader

Select files to upload

Create

Auto upload on drop

Likely:

- 10+ sample types
- 40+ process types

Yet missing:

- Reports
- Presentations
- Publications
- Grants
- ...

- Lab Notebook
- My Space (Car)
- Others
- Others (disabled)
- Inventory
  - Materials
    - Equipment
      - Characterization Equipment
      - Characterization Equipment External
      - Process Equipment
    - Samples
      - CIGS cells
    - Methods
      - Characterization
        - EQE
        - Four Point Probe
        - JV
        - SMS
        - TRPL
        - UV-Vis
        - XRF
      - Process
        - ALD
        - CSD
        - Ebeam BAK Old
        - Ebeam BAK Uni
        - Evaporation Thermal MBE
        - Evaporation Thermal Octoplus
        - Sputtering BAS 450
        - Sputtering Blasma2
        - Sputtering CT200
        - Substrate Cutting
      - Protocols
        - General Protocols
      - Publications
        - Public Repositories
        - Publications Collection
    - Stock
      - Stock Catalog
      - Stock Orders
    - Utilities
      - User Profile
      - Barcodes Generator
      - Object Browser
      - Vocabulary Browser
      - Advanced Search
      - Exports

## Object: PRC\_SPUT\_BLASMA8

/METHODS/PROCESS/PROCESS\_EXP\_5/PRC\_SPUT\_BLASMA8



### Parents

Filter  AND OR Options Columns

Code	Name	Modification Date
EQP_PRC5	Blasma 2	2020-02-20 09:10:52
SAM_CIGSCCELL25	Oct1763a	2020-02-20 09:22:15
SAM_CIGSCCELL26	Oct1763b	2020-02-20 09:22:15
SAM_CIGSCCELL27	Oct1763c	2020-02-20 09:22:15
SAM_CIGSCCELL28	Oct1763d	2020-02-20 09:22:15

1 - 5 of 5 items 10 Per Page Page 1 of 1

### General Properties

**Operator:**  
hera

**Timestamp Start:**  
2020-01-24 08:30:00 +0100

**Short process description:**  
ZnO:AL, 200W, 480sec, ~200nm

**Is process baseline?:**  
true

**Is process successful?:**  
true

### Process Specific

**Deposition Step Number:**  
1.0

**Target Material 1:**  
AZO

**Power 1 (W):**  
200.0

**Deposition Time (s):**  
8.0

**Gas 1:**  
15

**Gas Flow 1 (sccm):**  
5.0

**Pressure During Process (mbar/torr):**  
6.0E-4

**Substrate Temperature (deg C):**  
25.0

Select a dataset type

### Files Uploader



Select files to upload

Create

Auto upload on drop