

DTU



Jesper Hanberg, Henrik Nyholt, Thøger Eskildsen

A flexible equipment process datalog and sample tracking system

Process Data Logging

Cleanroom process data logging ...



Outline

- Instead we want ...
- Process Data Log System
 - User experience
 - Staff interface
 - Behind the scene
- Outlook



We want ...

- Automatic link between tool usage and log data
- Users to have concurrent access to log data
- Easy configurable fields for different tools
- Users to be reminded of entering and saving log data
- Users to be limited to edit/save their own data
- Different input field formats (numbers, text, lists, ...)
- Possibility to charge for expensive materials based on consumption
- Etc...



User experience

User experience

- Login screen (existing LabManager)

LabManager for DTU Nanolab (Bld. 346/347)

Present Project: Process Develop

Help | Logout: jehan

Technical University of Denmark DTU

Use Equipment

Equipment:

Favourites | DCH (All) | Last Used | Most popular (DCH) | Ready Again (DCH)

Important info - prior to using Aligner: MA6 - 2

Current status: New lamp

State changes since last usage

Changed	Headline
2019-06-06 15:02	New lamp
2019-06-04 14:23	Lamp life exceeded
2019-05-02 12:37	Proximity flags fixed
2019-03-25 16:25	rotation screw fixed
2019-03-25 15:25	no rotation possible
2019-03-04 11:15	New lamp
2019-03-04 10:02	service
2019-03-01 10:43	need new lamp
2019-01-17 16:11	Intensity adjusted
2018-11-22 13:41	New lamp installed
2018-11-22 11:29	Lamp change
2018-11-15 11:56	Needs a new lamp

Date of authorization: 2015-05-06

User manual: Manual for Aligner: MA6 - 2 (Updated: 2019-02-08)

Please note! The manual has been updated since last usage and must be read.

Start to use | Info

User experience

- After login: Process data log appears automatically ...

The screenshot displays the LabManager for DTU Nanolab (Bld. 346/347) interface. The main content area shows the 'Machine Process log for Aligner: MA6 - 2'. It includes a table of previous process log entries and an 'Edit entry' form for the current use.

Previous process log entry:

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
323193	2019-06-12 15:54:46	denhol-	1	SQ01	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		
			2	SQ02	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		
			3	SQ03	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		
			4	SQ04	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		
			5	SQ05	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		
			6	SQ06	Si	AZ MIR 701 1.5	1.5	DP, Window Hard	Used as is	11	18	198		

Edit entry:

Change project: Show Extra fields

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
323209	2019-06-12 16:41:35	jehan/-	1	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>

Buttons: reset, Save, show list to Copy from, Copy last line, Copy your previous entry (all lines)

Go to

Additional information: 2018-11-15 11:56 Needs a new lamp; Date of authorization: 2015-05-06; User manual: Manual for Aligner: MA6 - 2 (Updated: 2019-02-08); Please note! The manual has been updated since last usage and must be read.

Shows log data for previous use of tool

Input for current use

User experience

- Ready for input. Start time, user and project already set.

Edit entry:

Change project: Show Extra fields

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
323209	before	jehan-	1	[list+]	[list+]	[list+]	[µm]	[list+]	[list]	[list]	[mW/cm2]	[s]	[mJ/cm2]	[text]

reset Save

show list to Copy from Copy last line Copy your previous entry (all lines)

Go to

User experience

- User entering data: Now or after use.

Data entered
New line added

Edit entry:

Change project: Show Extra fields

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
				[list+]	[list+]	[list+]	[µm]	[list+]	[list]	[list]	[mW/cm2]	[s]	[mJ/cm2]	[text]
323209	before				Si/SiO2	AZ 5214E	1.5	bonding pads	Hard	Used as is	11	12	132	
	2019-06-12 16:41:35	jehan/-	1											
			2											

reset Save

show list to Copy from Copy last line Copy your previous entry (all lines)

Go to

User experience

- Full process log available. Only users own data editable. Possible to download as csv-file.

The screenshot displays the 'LabManager for DTU Nanolab (Bld. 346/347)' interface. At the top, there are navigation buttons: Front Page, Use equipment, Info, Favourites, List, Change Status, Booking, Orderlines, Edit Profile, and LabAdviser. On the right, there are buttons for Help, Logout (jehan), and the DTU logo.

The main content area shows 'Machine Process log for Aligner: MA6 - 2'. Below this, there are buttons for 'Download log as csv file' and 'Help on ProcessLog'. A table of process logs is displayed with columns: Usage ID, Start date, User/Operator, line, Tracking ID, Substrate, Resist, Thickness, Mask, Exp. type, Lamp setting, Intensity, Time, Dose, and Comments. The table contains multiple rows of data, including entries for 'before', '2019-06-12', and various operators like 'ahku/-', 'shasv/-', 'jesyup/-', 'nicobe/-', 'helloz/taran', 'azzul/-', 'erilian/-', 'denho/-', and 'jehan/-'.

Annotations include:

- A red box around the 'Export to csv file' button.
- A red circle around the 'Go to Process Log' button in the left sidebar.
- Arrows pointing from these annotations to their respective elements in the interface.

Searches

- Search/filtering possible in Process log table

Machine Process log for **Aligner: MA6 - 2** [Download log as csv file](#) [Help on ProcessLog](#)

[reset](#) [Extra fields hidden](#) [Status entries hidden](#) Showing 3242-3251 of 3251 entries. pr. page. Go to page: [1](#) [2](#) ... [326](#)

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
Filter:	<input type="text" value="before"/>	<input type="text"/>	<input type="text" value="&"/>	<input type="text" value="[list+]"/>	<input type="text" value="[list+]"/>	<input type="text" value="[list+]"/>	<input type="text" value="[µm]"/>	<input type="text" value="[list+]"/>	<input type="text" value="[list]"/>	<input type="text" value="[list]"/>	<input type="text" value="[mW/cm2]"/>	<input type="text" value="[s]"/>	<input type="text" value="[mJ/cm2]"/>	<input type="text" value="[text]"/>
322796	2019-06-07 14:00:41	ahku/-	1	SD07062019	Borofloat	AZ 1505 2020 2		SDX 20-10-17 - Chromium	Hard	Used as is	11	11	121	Four wafers processed
322812	2019-06-07 14:56:10	shasw/-	1	Process U5	Si/SiO2	AZ 5214F	4.2		Flood-E	Used as is	11	18	198	Flood exposure for image reversal
322828	2019-06-07 16:33:00	ieswup/-	1		Si	SU-8 2035	17			Used as is	11	23	253	

Filtering fields

Searches

- Sample tracking across different tools for projects possible

LabManager for DTU Nanolab (Bld. 346/347)

Present Project
Process Develop

?
Help

Logout
jehan

Technical University
of Denmark

Sample Tracking in Process logs

Search project:

Search user:

Search Date interval: to

Search Tracking ID: OR

Wildcards: _ and %

full log entries

Tracking log for
Project 'DTU Nanolab QU20160228'; Tracking ID = " OR Tracking ID = "; User =" from 2017-01-18 to 2019-06-12

(click each line to toggle view on/off)

1 - Tool: Spin Coater: Gamma UV on 2017-01-18 09:58:14 uid= 246159

Usage ID	Start date	User/Operator	line	Tracking ID	Recipe	Wafers	Comments
	before			[list+]	[list+]	[#]	[text]
edit	2017-01-18 09:58:14	chou-	1	Ricb01	2410-DCH 100mm nLOF 2020 1.5um	1	
			2	Ricb01	2621-dc	6	
			3		0400 100mm Coter clean	1	

2 - Tool: Aligner: MA6 - 2 on 2017-01-18 10:46:54 uid= 246172

Usage ID	Start date	User/Operator	line	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
	before			[list+]	[list+]	[list+]	[µm]	[list+]	[list]	[list]	[mW/cm2]	[s]	[mJ/cm2]	[text]
edit	2017-01-18 10:46:54	chou-	1	Ricb01	Si	AZ nLOF 2020 2		hydrophobic	Hard	Used as is	13	8	104	

3 - Tool: Developer: TMAH UV-lithography on 2017-01-18 10:56:45 uid= 246175

Usage ID	Start date	User/Operator	line	Tracking ID	Resist	Thickness	Recipe 1	Recipe 2	Wafers	Comment
	before			[list+]	[list+]	[µm]	[list+]	[list+]	[#]	[text]
edit	2017-01-18 10:56:45	chou-	1	Ricb01	AZ nLOF 2020 2	3010 - 150mm 60s peb@110C - SP 60 s			6	

4 - Tool: Optical Profiler (Sensofar) on 2017-01-18 13:09:32 uid= 246197

Usage ID	Start date	User/Operator	line	Tracking ID	No data logging required

Staff interface



Staff interface to set-up

- Individual configurable for each tool
- Free choice of parameter name and type

LabManager for DTU Nanolab (Bld. 346/347)

Present Project
Process Develop

?
Help

Logout
jehan

Technical University of Denmark

Machine Process parameters for Aligner: MA6 - 2

Delete item by deleting the 'parameter' field. If the item is not removed it is because there already exist log-entries with this parameter filled in.

id	390	391	392	1085	393	397	394	395	396	1084	
parameter	<input type="text" value="Substrate"/>	<input type="text" value="Resist"/>	<input type="text" value="Thickness"/>	<input type="text" value="Mask"/>	<input type="text" value="Exp. type"/>	<input type="text" value="Lamp setting"/>	<input type="text" value="Intensity"/>	<input type="text" value="Time"/>	<input type="text" value="Dose"/>	<input type="text" value="Comment"/>	
showorder	<input type="text" value="9999"/>	<input type="text" value="10"/>	<input type="text" value="20"/>	<input type="text" value="30"/>	<input type="text" value="40"/>	<input type="text" value="50"/>	<input type="text" value="60"/>	<input type="text" value="70"/>	<input type="text" value="80"/>	<input type="text" value="90"/>	<input type="text" value="100"/>
unit	<input type="text" value="list+"/>	<input type="text" value="list+"/>	<input type="text" value="µm"/>	<input type="text" value="list+"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="mW/cm2"/>	<input type="text" value="s"/>	<input type="text" value="calc mJ/cm2"/>	<input type="text" value="text"/>	
isrequired	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	
title	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="Resist thickness"/>	<input type="text" value=""/>	<input type="text" value="Exposure type"/>	<input type="text" value=""/>	<input type="text" value="Lamp intensity (channel 2)"/>	<input type="text" value="Exposure time"/>	<input type="text" value="Math.round(c[394]*c[395]*100)/100"/>	<input type="text" value=""/>	
list items	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Borofloa Quartz Si SiO2 < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ 4562 AZ 5214E AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Flood- Hard Low Vac < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Ignited Switched off Used as is < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ < > ..</div>

this is how it will look:

Machine Process log for Aligner: MA6 - 2

Start date	Close date	User/ Operator	line no	ProcessingDone	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
			[text]	[list+]	[list+]	[list+]	[list+]	[µm]	[list+]	[list]	[list]	[mW/cm2]	[s]	[calc mJ/cm2]	[text]
2014-01-01 10:00:00		jehan /	1	<input type="text" value="text"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="488"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="836"/>	<input type="text" value="454"/>	<input type="text" value="832"/>	<input type="text" value="text"/>

Go to Process Log

Staff interface to set-up

- Types (unit):

LabManager for DTU Nanolab (Bld. 346/347)

Present Project
Process Develop

?
Help

Logout
jehan

Technical University of Denmark

Machine Process parameters for Aligner: MA6 - 2

Delete item by deleting the 'parameter' field. If the item is not removed it is because there already exist log-entries with this parameter filled in.

id	390	391	392	1085	393	397	394	395	396	1084	
parameter	<input type="text" value="Substrate"/>	<input type="text" value="Resist"/>	<input type="text" value="Thickness"/>	<input type="text" value="Mask"/>	<input type="text" value="Exp. type"/>	<input type="text" value="Lamp setting"/>	<input type="text" value="Intensity"/>	<input type="text" value="Time"/>	<input type="text" value="Dose"/>	<input type="text" value="Comment"/>	
showorder	<input type="text" value="9999"/>	<input type="text" value="10"/>	<input type="text" value="20"/>	<input type="text" value="30"/>	<input type="text" value="40"/>	<input type="text" value="50"/>	<input type="text" value="60"/>	<input type="text" value="70"/>	<input type="text" value="80"/>	<input type="text" value="90"/>	<input type="text" value="100"/>
unit	<input type="text" value="list+"/>	<input type="text" value="list+"/>	<input type="text" value="µm"/>	<input type="text" value="list+"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="mW/cm2"/>	<input type="text" value="s"/>	<input type="text" value="calc mJ/cm2"/>	<input type="text" value="text"/>	
isrequired	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	<input type="text" value="All"/>	
title	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value="Resist thickness"/>	<input type="text" value=""/>	<input type="text" value="Exposure type"/>	<input type="text" value=""/>	<input type="text" value="Lamp intensity (channel 2)"/>	<input type="text" value="Exposure time"/>	<input type="text" value="Math.round(c[394]*c[395]*100)/100"/>	<input type="text" value=""/>	
list items	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Borofloa Quartz Si SiO2 < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">AZ 4562 AZ 5214E AZ < > ..</div>	<input type="text" value=""/>	<input type="text" value=""/>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Flood- Hard Low Vac < > ..</div>	<div style="border: 1px solid gray; padding: 2px; font-size: x-small;">Ignited Switched off Used as is < > ..</div>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	<input type="text" value=""/>	

reset
save

this is how it will look:

Machine Process log for Aligner: MA6 - 2

Start date	Close date	User/ Operator	line no	ProcessingDone	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
			[text]	[list+]	[list+]	[list+]	[list+]	[µm]	[list+]	[list]	[list]	[mW/cm2]	[s]	[calc mJ/cm2]	[text]
2014-01-01 10:00:00		jehan /	1	<input type="text" value="text"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="488"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="list"/>	<input type="text" value="836"/>	<input type="text" value="454"/>	<input type="text" value="832"/>	<input type="text" value="text"/>

reset
save
Save&Close

Go to Process Log

Staff interface to set-up

- Types (unit):
 - Number: entered with their used unit: e.g. nm, Watt, mbar, ...
 - Text: multiline text fields
 - List+: Dropdown fields
 - Calc: calculated field based on data from previous line entry or current

LabManager for DTU Nanolab (Bld. 346/347)

Present Project: Process Develop

Help | Logout: jehan

Technical University of Denmark

Machine Process parameters for **Aligner: MA6 - 2**

Delete item by deleting the 'parameter' field. If the item is not removed it is because there already exist log-entries with this parameter filled in.

id	parameter	390	391	392	1085	393	397	394	395	396	1084
		Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comment
showorder	9999	10	20	30	40	50	60	70	80	90	100
unit		list+	list+	µm	list+	list	list	mW/cm2	s	calc mJ/cm2	text
isrequired		All	All	All			All	All	All		
title			Resist thickness			Exposure type		Lamp intensity (channel 2)	Exposure time	Math.round(c[394]*c[395]*100)/100	
list items		Borofloa Quartz Si SiO2	AZ 4562 AZ 5214E AZ			Flood- Hard off Low Vac	Ignited Switched off Used as is				

reset save

this is how it will look:

Machine Process log for **Aligner: MA6 - 2**

Start date	Close date	User/ Operator	line no	ProcessingDone	Tracking ID	Substrate	Resist	Thickness	Mask	Exp. type	Lamp setting	Intensity	Time	Dose	Comments
2014-01-01 10:00:00		jehan /	1	text	list	list	list	468	list	list	list	836	454	832	text

reset save Save&Close

Go to [Process Log](#)

Behind the scenes

Behind the scenes

- LAMP server running DTU Nanolab LabManager system
- Process data log is an add-on to existing database
- Requires only three tables in database:

LAMP:

- Linux
- Apache
- MySQL
- PHP

Process log lines

Logline_id	Line	Usage_id
17	1	3456
18	2	3456
19	1	4356

Tool parameters

Parameter_id	Tool_id	Parameter	Type	order
101	43	Substrate	list+	10
102	43	Resist	list	20
103	43	Thickness	µm	30
104	56	Recipe	text	

Process log DATA

ID	Logline_id	Parameter_id	Log data
3007	17	101	Si/SiO2
3008	17	102	AZ 5214E
3009	17	103	1.5
3010	19	104	Ti/Au

Outlook

- Automatic logging of data for tools
 - implemented on one tool where it works fine
- Alarm (e-mail) when a calculated field reach zero.
 - Can as an example be used for chemical baths when they need to be changed.
- We have ideas for more features, but not the time to implement 😞

Thank you

