



# **Epiportal User Instructions**

## Introduction.

This is a step by step guide in how to create a growth request using the EPSRC National Epitaxy Facility (NEF) Epiportal. The Epiportal allows the customer to log in and build a growth structure, layer by layer to the specifications required. Resulting in improved communication with the customer, and also consistent record keeping of wafers grown and supplied by the NEF.

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## 1. The Epiportal

The Principle Investigator (PI), who holds a current EPSRC grant with the NEF, will be given an account to access the epiportal, where they can oversee all growth requests made against their grant or any other grants that they may hold. Additionally if the PI requests it, the NEF can also add accounts for RAs and students to the grant, so that they can also make requests via the Epiportal. Access for RAs and students will only be given with the authority of the PI of the grant. Contact R. Airey (r.airey@sheffield.ac.uk), giving the name of the RA/student, their email address and details of the grant they can access.

## NOTE: ALL GRANTS AND USER ACCESS DETAILS ARE TREATED AS CONFIDENTIAL BY THE NEF.

## 1.1. Logging in

The log in page for the NEF Epiportal is located at: <u>https://epitaxy.eee.shef.ac.uk</u>. It can also be reached by going to the NEF website and clicking on the link labelled 'EPIPORTAL', at the bottom of the website screen.

Enter the User email address and the password provided by the NEF to access the epitaxy request page (any problems logging in, contact: Rob Airey). Once logged on, the User will be presented with either a screen with no growth requests against the grant (see figure 1 below). Or if an established User on the epiportal, all the current requests under the User's active grant will appear on the screen, as shown in figure 2.

PITAXY ACILITY			an other 👻
MY REQUESTS			
✓ Signed in successfully.			×
GRANT NAME - TEST Sponsor: University of Test Funding Type: EPSRC Date: 01/01/2021 - 01/12/2024 PI: AN Other@test ac uk	Value: £XXX		+ New request
Structure	Status	Submitted by	
			Q View details 🔀 Duplicate

Figure 1 - View of requests screen for a grant without any requests made on it.

NATIONAL EPITAXY FACILITY	and Physical Sciences uncil		( AN OTHER -
MY REQUEST	S		
<ul> <li>Signed in successfully.</li> </ul>			×
GRANT NAME - TEST Sponsor University of Teat Funding Type: EPSIC Date: 01/01/22/1 - 01/12/202 PI: AN Other@lest.ac.uk	4 Value: £ xxx Status	Submitted by	+ New request
2021/01/01/1/1	Growing	You	Q. View details (3 Duplicate
2021/01/02/1/1	Submitted	You	Q. View details
2021/01/02/1/2	New structure	You	Delete     Q View details     ID Duplicate

Figure 2– View of request screen for an established User with grant requests in place and their status: Growing, Submitted and New Structure.



## 2. Creating a growth request

To create a request simply click on the <u>**'+ New Request</u></u>' button in the '<b>MY REQUESTS**' page in figure 3 below. This will open the screen shown below in figure 4.</u>

ACILITY	iences			AN OTHER •
MY REQUESTS				
<ul> <li>Signed in successfully.</li> </ul>			$\sim$	×
GRANT NAME - TEST Sponsor: University of Test Funding Type: EFSRC Date: 01/01/2021 - 01/12/2024 PI: AN.Other@test.ac.uk	Value: £ XXX			+ New request
Structure	Status	Submitted by		
				Q View details Duplicate

Figure 3 – Generating a new request

## 2.1. General Information & Substrate Requirements

NATIONAL EPITAXY FACILITY	GROWTH STRUCTURE	2021/04/16/1	1/1				NOT YOU? / LOG OUT
2021/04/16/1/1	General Information	📚 Layers	🛎 Characterisation	Documents			Duplicate Delete
<ul><li>Submit this structure</li><li>K Back to my requests</li></ul>	Reference number 2021/04/16/1/1				IOT ENTER ANYTHI JLATED BY THE EP		BOX – IT IS
	Number of Wafers 1 Purpose Test purposes			ß			
	Substrate Material Type GaAs	•	Doping Type Undoped	•	Polish Single Sided	•	
	Size 2"	•	Crystal Orientation (100)	•	Offcut Orientation No Offcut	•	
	Offcut Angle O	•					
©2021 epiGenesys	B Save						

Figure 4 – General information and defining the substrate requirements

At this point the request is in edit mode and the User can change the details of the request (substrate and layer structure), as much as they wish. **DO NOT** click on the '**Submit this structure**' button at the left of the webpage until all the details of the request (substrate, layers, characterization requirements and additional doc information) are entered. As this will move the request out of edit mode and it can no longer be changed.

The first field is the reference number field, which is automatically populated with the date of the request and also the order of the request for that date, e.g. **2021/04/16/1/1** – indicates that the request was made on 16<sup>th</sup> April 2021 and is the first growth structure of the first request on this date. The next two fields, '**Number of Wafers**' and '**Purpose**' are text fields where the User can enter the number of wafers to be delivered and also comment on the purpose that the final product is to be used (the purpose is optional, but helps put the growth into context with the overall aim of the research grant).

Below the general information section are the substrate properties fields These are completed by using the drop down menus for each of the substrate fields and selecting the appropriate requirements.

In the example given in figure 4 above, the substrate properties are:

Materials type – GaAs, Doping type – Undoped, Polish – Single Sided, Size – 2", Crystal Orientation - (100),

Offcut Orientation – **No offcut**, Offcut Angle - **0**.

Once the fields are completed, click on 'Save'. The substrate details are now entered into the request.





## 2.2. Layer Requirements

Click on the 'Layers' tab at the top of figure 4 to open the layers webpage, figure 5 below. This shows the substrate as layer 0, and layers are ready to be added.

RATIONAL EPITAXY FACILITY	GROWTH STRUCTURE 2021/04/16/1/1	NOT YOU? / LOG OUT
2021/04/16/1/1	⑧ General Information \$ Layers ▲ Characterisation ■ Documents	Duplicate Delete
<ul> <li>Submit this structure</li> <li>Back to my requests</li> </ul>	Add a new layer on top 0. Substrate (GaAs) Click here to add a new layer to the structure	

Figure 5 – The initial layout of the layers page.

Clicking on the 'Add a new layer on top' button shown in in figure 5 above will open up the layer details webpage (figure 6 below).

### 2.2.1. Specifying layer details

2.1. Specifyir	ig layer details	Click the 'Submit the structure' bu	utton to submit the request.
RATIONAL EPITAXY FACILITY	GROWTH STRUCTURE 2021/04/16/1/1	Once again be aware that once th	his button is activated it
2021/04/16/1/1	General Information     S Layers     Characterisation     Documents	will no longer be possible to edit	the request
Submit this structure Back to my requests	🗲 Add a new layer on top		
i.	Repeats 1		
	Material Composition Group III (100% in toxa) Al % Ca % 100 In %	be entered into the epiportal	the minimum information that shall I for this example, that of a single n in thickness, doped to 1E18/cm <sup>3</sup> .
	Group IV Si % Ge % Sn %	The text fields under the gre optional and are explained in	een semi-transparent area are n step <b>vii</b>
	Group V (100% in total)           N %         P %         Ø 100         Sb 4	% BI %	vi.
iv.		boping Type 🗸 🗸	Doping Level /cm <sup>3</sup>
vii	Thickness Tolerance Other -	Doping Tolerance Other ~	Material Tolerance Other *
	Target Wavelength nm V	Vavelength Tolerance nm	
	X Cancel edit		VIII. 🛱 Save layer
	0. Substrate (GaAs)		

Figure 6 – Adding a layer details

To add a layer, carry out the following steps:

- i. Enter the number of times the layer is to be repeated, the default number is '1', for a single layer.
- ii. Select the material composition by clicking the check box next to the element required, e.g. for GaAs select 'Ga' from the Group III section and 'As' from the Group V section (see figure 7, page 5).
- iii. Once checked, click on the element text to enter the percentage of the element to be incorporated into the layer (figure 7, page 5), e.g. for the GaAs layer in figure 6, set the Ga to 100% and the As to 100% also. Note: for each of the element groups (III, IV or V), the total percentage of elements from each group must add up to 100%. For example, if a layer such as 30% AIGaAs was required, the ratio of percentages for the group III elements entered into the text fields, shall be AI 30%, Ga 70% and the group V, element As 100%.
- iv. Next enter the layer thickness text field and enter the desired thickness for the layer, e.g. 100. The units of thickness default to nm, but um and Å can be chosen from the drop down menu that appears when the 'nm' text is clicked on.
- v. Select the doping type by clicking anywhere in the 'Doping Type' text field. The options are: N,P, Undoped and Semi-insulating





vi. Enter a doping level using the format **1E18**. If the layer is undoped then 0.0 can be entered. However, be aware that this is not a realistic doping level and will be taken as an indication as requiring a doping level as low as possible for this layer.

GROWTH STRUCTURE	2021/04/16/	/1/1			AN OTHER NOT YOU? / LOG OUT
General Information	📚 Layers	🔺 Characterisation	Docume	ents	Duplicate
Add a new layer on top					
Repeats 1					
Material Compos Group III (100% in total)	sition				
Al %	Ga % 100		%		
Group IV					
□ Si %	🗌 Ge %	□ Sr	ו %		
Group V (100% in total)					
□ N %	□ P %	As 10		Sb %	□ Bi %
N %	P %	10	00	SD %	BI %

Figure 7 – Selecting the group elements and their composition percentages

vii. For this step the text fields shown under the green semi-transparent box in figure 6 are optional. These fields allow the User to define any critical growth requirements beyond those entered in steps **i-vi**.

The fields are: **Thickness Tolerance**, **Doping Tolerance** and **Material Tolerance**. These tolerances can be expressed in terms of Percentage, Absolute and Other, selected from the drop down menu at the end of each of these text field boxes.

viii. Once all the layer requirements are entered click on 'Save Layer' to confirm the layer into the structure. This will result in the webpage shown in figure 8 below. Figure 8 displays the details of the layer or layers entered into the structure. If any details are incorrect then clicking on the 'edit' button will open the layer edit page again, as shown in figure 7, so that corrections can be made.

GR	OWTH STRUCTURE	2021/04/16	/1/1	AN OTHER NOT YOU? / LOG OUT
i	General Information	Layers	Le Characterisation	Duplicate
ళ	Add a new layer on top		Click the duplicate button to replicate this layer and its details, in a new layer (see figure 9)	
	1. GaAs (100nm) Doping Type: N, Leve	el: 1e18/cm <sup>3</sup>	Le Dup	licate 🛛 🖄 Edit 🗍 Delete
	0. Substrate (GaAs	)		

Figure 8 – Confirmed layer with details displayed

ix. To add another layer click on the 'Add a new layer on top' in the edit page, or click on the lower 'Duplicate' button (figure 8) to replicate that particular layer. Once again the page will display the text fields and also the previously added layers, see figure 9.





GROWTH STRUCTURE 2	2021/04/16	/1/1					AN OTHER NOT YOU? / LOG OUT
<ol> <li>General Information</li> </ol>	Layers	🛎 Characterisation	Documents				Duplicate
st Add a new layer on top							
Repeats 1			:				
Material Compos	ition						
Group III (100% in total)							
Al %	Ga % 100	🗌 In %					
Group IV							
🗆 Si %	🗌 Ge %	🗆 Sn %					
Group V (100% in total)							
□ N %	P %	As % 100		Sb % 🗌 Bi %			
Thickness 100.0			nm ~	Doping Type N	*	Doping Level 1e18	/cm <sup>3</sup>
Thickness Tolerance			Other -	Doping Tolerance	Other -	Material Tolerance	Other -
Target Wavelength			nm	Wavelength Tolerance	nm		
× Cancel edit							🖬 Save layer
<ol> <li>GaAs (100nm) Doping Type: N, Level: 3</li> </ol>	le18/cm <sup>3</sup>						Duplicate 🖉 Edit 🗍 Delete
0. Substrate (GaAs)							

Figure 9 – Layer edit page generated by 'Added layer' or 'Duplicate layer' functions

**x.** Repeat steps **i** to **ix** to place the required layers and their details into the structure. Figure 10 shows a completed structure with several layers after following steps **i**-**ix**.

GROWTH STRUCTURE 2021/04/16	5/1/1	AN OTHER NOT YOU? / LOG OL
General Information     Supersection	🗠 Characterisation 📑 Documents	Duplicate
Add a new layer on top		
7. GaAs (50nm) Doping Type: P, Level: 1e19/cm <sup>3</sup>		Duplicate 🔀 Edit 🗍 Delete
■ 6. Al <sub>0.3</sub> Ga <sub>0.7</sub> As (7nm)		Duplicate
11 5. GaAs (5nm)		Duplicate
1 4. InAs (0.7nm)		Duplicate
3. GaAs (5nm)		Duplicate
■ 2. Al <sub>0.3</sub> Ga <sub>0.7</sub> As (7nm)		Duplicate
■ 1. GaAs (100nm) Doping Type: N, Level: 1e18/cm <sup>3</sup>		Duplicate
0. Substrate (GaAs)		

Figure 10 – Completed layer structure





#### 2.3. I've finished the structure. What's next?

If the structure is finished then the User can either click on the **Characterisation** option (see section **2.4**), or select the **Documents** option (see section **2.5**) located at the top of the webpage shown in figure 9. The **Characterisation** and **Documents** sections do not have to be completed, but are there to provide the opportunity to supply any additional information in order to help the NEF meet the User's requirements. If satisfied that there is enough information to carry out the growth then the User can either:

- i. Logout and the system will hold the request at that point or,
- ii. Click on the 'Submit this structure' (see figure 6), to finalize the request and/or,
- iii. If another growth request is required, but has slight changes in structure to the one just submitted. Then clicking on the upper 'Duplicate' button at the top of the webpage (figure 11a), will copy the entire contents of the current growth request into a new, separate growth request as shown in figure 11b.
   Note the change in Epiportal reference numbers from 2021/0/16/1/1 to 2021/04/16/1/2 in figure 11b.

The User can then go into this new, duplicate request and alter the structure (substrate and/or layers) as they need (figure 11c). This makes it quicker and less tedious, for the User to add several growth requests that may only need small modifications, such as a altering the thickness and/or doping level of a single layer.



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GROWTH STRUCTURE 2021/04/16/1/1	O AN OTHER NOT YOU? / LOG OL	Clicking the top Duplicate button <b>2021/04/16/1/1</b> . Generating a ne	w request 2021/04/16/1/
1 General Information 📚 Layers 🔺 Characterisation 🖹 Documents	Duplicate	and opens the new one in the su	Ibstrate page
💰 Add a new layer on top			
7. GaAs (50mm) Doping Type: P, Level: 1e19/cm <sup>3</sup>	Delete		
II 6. Al <sub>0.3</sub> Ga <sub>0.7</sub> As (7nm)	GROW URE 2021/04/	/16/1/2	AN OTHER NOT YOU? / LO
II 5. GaAs (5nm)	slica 🖲 Gen 👘 📚 Layei	rs ڬ Characterisation 📓 Documents	Duplicate
₩ 4. InAs (0.7nm)	Duplica Referen		
II 3. GaAs (5nm)	Puplica Number of Wafers		
II 2. Al <sub>0.3</sub> Ga <sub>0.7</sub> As (7nm)	III Duplica Purpose		
II 1. GaAs (100nm)	Test purposes		
Doping Type: N, Level: leiS/cm <sup>3</sup> 8. Substrate (GaAs)	Substrate		
	Material Type GaAs	Doping Type     Undoped     Polish     Single Sided	•
Figure 11a	Size 2"	Crystal Orientation     (100)     Offcut     Offcut	-
	Offcut Angle O	*	
Information SLayers Characterisation Documents	AN OTHER NOT YOU? / LOG OUT     Duplicate     Delete		
		Figure 11b	
Information 📚 Layers 🖿 Characterisation 🖹 Documents w layer on top s (50nm)			he layer page can be
Information Sector Layers Characterisation Documents w layer on top s (50nm) ng Type: P, Level: 1e19/cm <sup>3</sup>	NOT YOU? / LOG OUT      Duplicate     Duplicate     Duplicate     Duplicate     Duplicate	From the new substrate page the opened, showing the that the la	
Information Layers Characterisation Documents w layer on top s (50nm) ng Type: P, Level: 1e19/cm <sup>3</sup> .3Ga <sub>0,7</sub> As (7nm)	NOT YOU? / LOG OUT      Duplicate     D	From the new substrate page the opened, showing the that the la over to the new request.	ayers have been copied
Information Layers Characterisation Documents w layer on top s (59nm) ag Type: P, Level: 1e19/cm <sup>3</sup> agGa <sub>0.7</sub> As (7nm) s (5nm)	NOT YOU? /LOG OUT      Duplicate     Du	From the new substrate page the opened, showing the that the la	ayers have been copied
Information Layers Characterisation Documents w layer on top s (50nm) ng Type: P, Level: 1e19/cm <sup>3</sup> .3Ga <sub>0,7</sub> As (7nm)	NOT YOU? / LOG OUT      Duplicate     D	From the new substrate page the opened, showing the that the la over to the new request. Clicking on the individual layer	ayers have been copied
Information Layers Characterisation Documents w layer on top s (59nm) ag Type: P, Level: 1e19/cm <sup>3</sup> agGa <sub>0.7</sub> As (7nm) s (5nm)	NOT YOU? /LOG OUT      Duplicate     Du	From the new substrate page the opened, showing the that the la over to the new request. Clicking on the individual layer	ayers have been copied
Information Layers Characterisation Documents w layer on top s (50nm) ng Type: P, Level: 1e19/cm <sup>3</sup> .3Ga <sub>0</sub> ,7As (7nm) s (5nm) s (0.7nm)	Not You? / Log OUT	From the new substrate page the opened, showing the that the la over to the new request. Clicking on the individual layer	ayers have been copied
Information Layers Characterisation Documents w layer on top s (50nm) ng Type: P, Level: 1e19/cm <sup>3</sup> 3Ga <sub>0</sub> .7As (7nm) s (5nm) s (0.7nm) s (5nm)	<ul> <li>NOT YOU? / LOG OUT</li> <li>Duplicate</li> <li>Duplicate</li> <li>Edit</li> <li>Delete</li> </ul>	From the new substrate page the opened, showing the that the la over to the new request. Clicking on the individual layer	ayers have been copied



The new, duplicated request will appear in the User's '**MY REQUESTS**' page. Showing what requests have been placed with the NEF, and their status (figure 11).

GRANT NAME	- TEST		+ New request			
Sponsor: University of She Funding Type: EPSRC	effield					
Date: 01/01/2021 - 01/06/2024 Value: £0.00						
PI: AN.Other@test.ac.	PI: AN.Other@test.ac.uk					
Structure	Status	Cub maittad but				
	Status	Submitted by				
GRANT NAME Sponsor: University of She Funding Type: EPSRC Date: 01/01/2021 - 0 Pl: AN.Other@test.ac. Structure 2021/04/16/1/1	Submitted	You	Delete Q View details Duplicate			

Figure 12 - Summary of Users Requests

### 2.3.1. Repeating a structure that has been delivered.

To repeat a growth request that has been delivered, simply click on the '**Duplicate**' button shown in figure 12 above. Another request will appear in the list with the status: '**New structure**'. Carry out the steps described in section **2.1**., to ensure the substrate and the layers are what is required.

### 2.4. Characterisation options

- i. Choose the 'Characterisation' tab (figure 10) and opt for any of the available characterisation methods as follows:
- ii. Click on the '+ Add a new characterisation" button (figure 13)
- iii. Then select the desired characterisation method from the drop down menu figure 14, e.g. eCV.
- iv. Fill in the '**Purpose**' field to let the NEF staff know what you wish to find out from the characterization, to ensure the data is supplied and interpreted accordingly (figure 15).
- v. Click 'Save' to ensure the characterisation details are retained in the request.

If the characterization option is left blank, quality assurance tests are still carried out as standard on the wafer, to ensure customer satisfaction.

NATIONAL EPITAXY FACILITY	GROWTH STRUCTURE 2021/04/16	AN OTHER NOT YOU? / LOG OUT		
2021/04/16/1/1	i General Information 📚 Layers	🛎 Characterisation	Documents	Duplicate Delete
<ul><li>Submit this structure</li><li>Back to my requests</li></ul>	+ Add a new characterisation			
©2021 epiGenesys				

Figure 13 – The characterisation page



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OWTH STRUCTURE 2021/04/16	/1/1		AN OTHER NOT YOU? / LOG OUT
General Information 📚 Layers	A Characterisation	Documents	Duplicate
Method 👻	]		
Room Temp PL Mapping			
Low Temp PL micro PL			
PL			
Room Temp Reflectivity Mapping			
Reflectivity XRD			Save
eCV			
Hall			
AFM			
SEM			
Nomarski			
Other			

Figure 14 - Selecting a characterisation option from the drop down menu

GROWTH STRUCTURE 2021/04/16/1/1			NOT YOU? / LOG OUT	
i General Information	Layers	Characterisation	Documents	Duplicate
Method eCV	•			
Purpose Test				
× Cancel edit				G Save

Figure 15 - Stating the purpose of the characterisation task





## 2.5. Uploading additional information

Users can include any further information that may be relevant to the request by doing the following:

- i. Choose the 'Documents' tab (figure 15)
- ii. Click on the 'Browse' button (figure 16) and selecting the document file to be included.
- iii. Click on the 'Upload' button to attach the document to the request (figure 16).
- iv. The page will then display that the document has been successfully uploaded (figure 16).

GROWTH STRUCTURE	2021/04/16/	1/1		AN OTHER NOT YOU? / LOG OUT
<ol> <li>General Information</li> </ol>	📚 Layers	🛎 Characterisation	Documents	Duplicate Delete
Upload new doci	uments			
Documents	Browse			
ᆂ Upload	No file chosen			
Documents				
Additional_info.pdf				🗍 Delete

Figure 16 – showing a document has been uploaded to the request

#### 3. The End.

This concludes the instructions on how to enter a growth request to the NEF Epiportal. Except to say once again, that all requests are treated in confidence by the NEF staff. No other researchers can see a User's request unless they are part of the same research group/grant and have been given permission to access the NEF Epiportal by the principle investigator of that particular research grant.

If any problems do occur whilst entering a request then please contact Dr Rob Airey, email: r.airey@sheffield.ac.uk