NATIONAL EPITAXY FACILITY | EPSRC Engineering and Physical Sciences Research Council | Universities of Sheffield Cambridge & University College London

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.

CONTENTS:

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: https://epitaxy.eee.shef.ac.uk. 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.

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

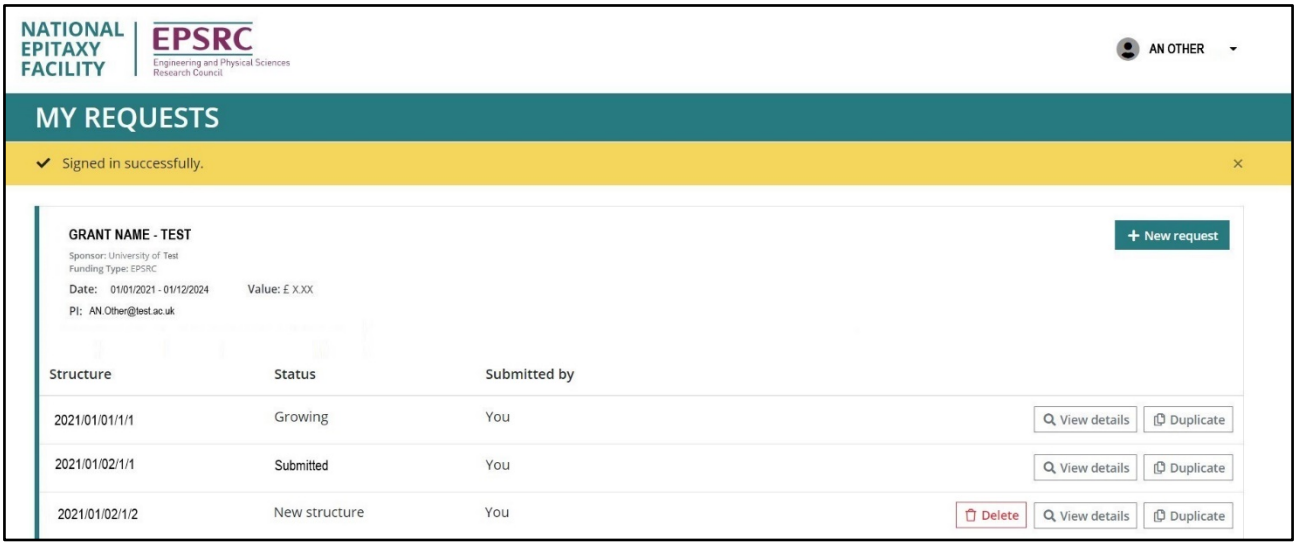

Figure 2– View of request screen for an established User with grant requests in place and their status: Growing, Submitted and New Structure.

2. Creating a growth request

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

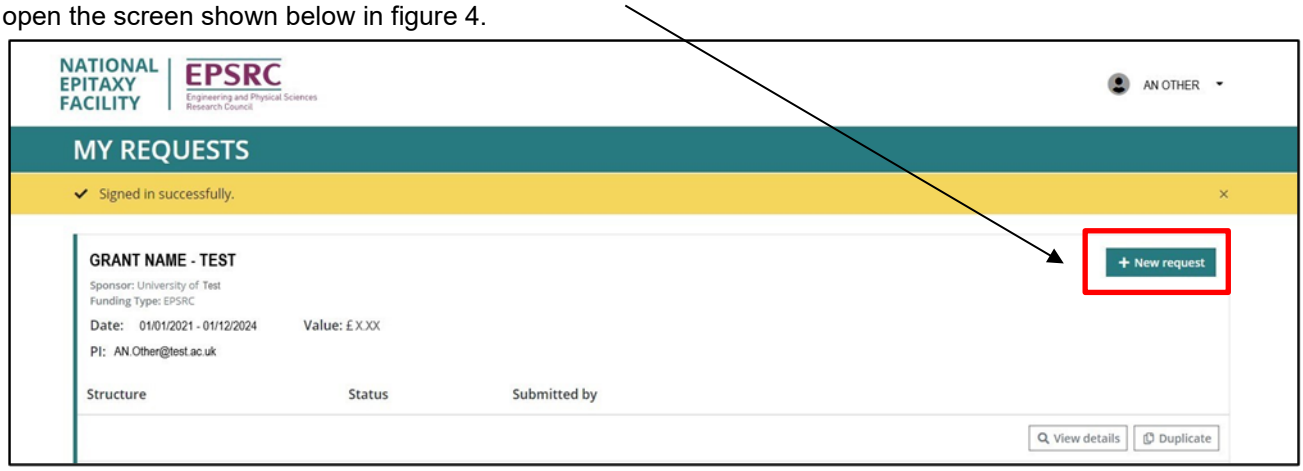

Figure 3 – Generating a new request

2.1. General Information & Substrate Requirements

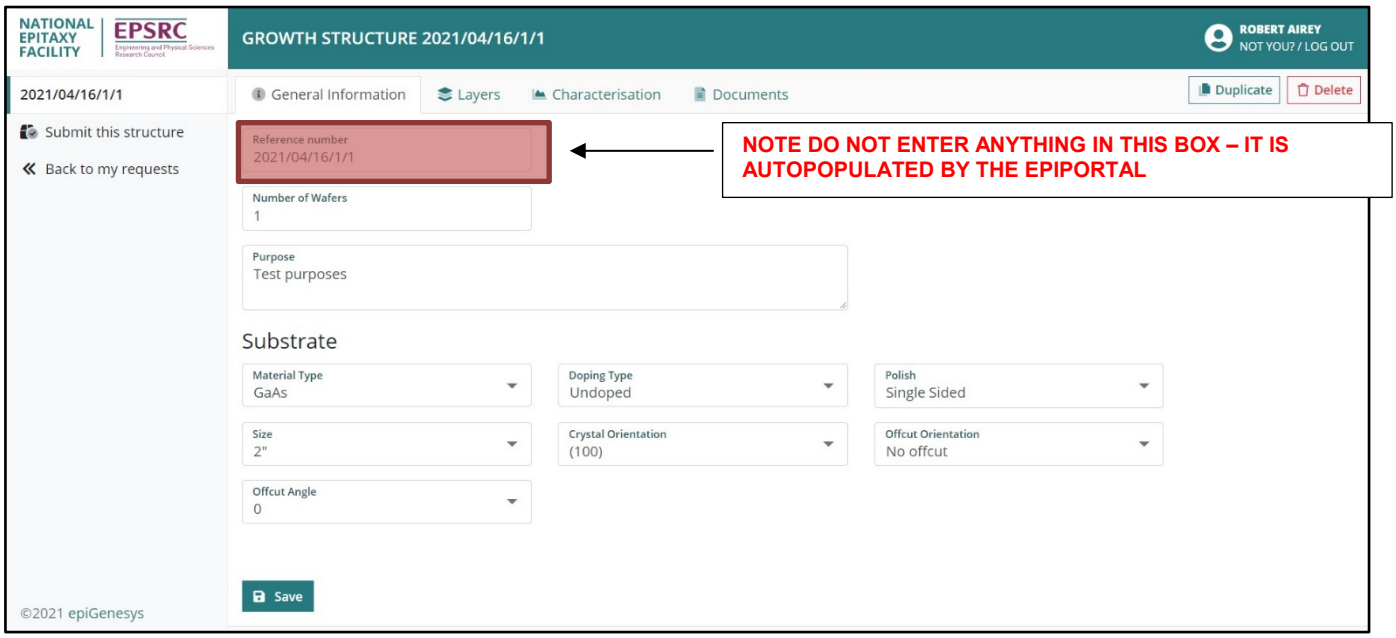

Figure 4 – General information and defining the substrate requirements

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 16th 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.

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

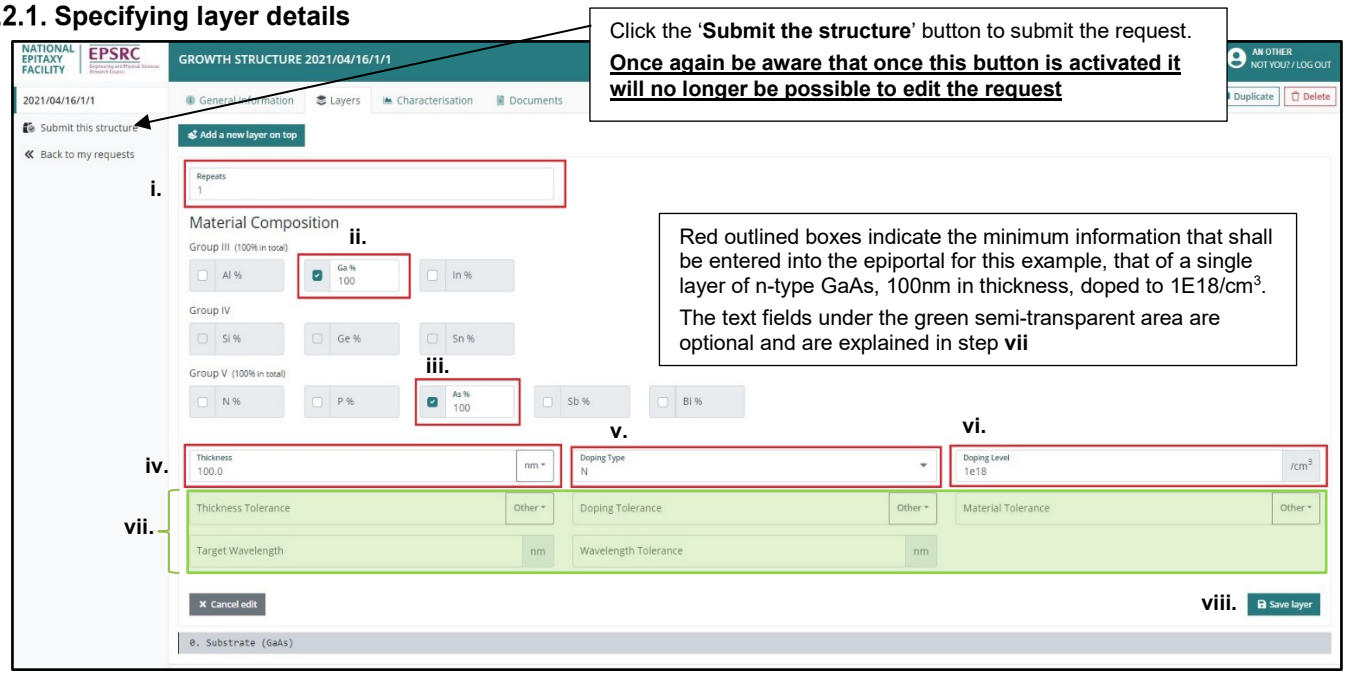

Figure 6 – Adding a layer details

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%AlGaAs** was required, the ratio of percentages for the group III elements entered into the text fields, shall be **Al 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.

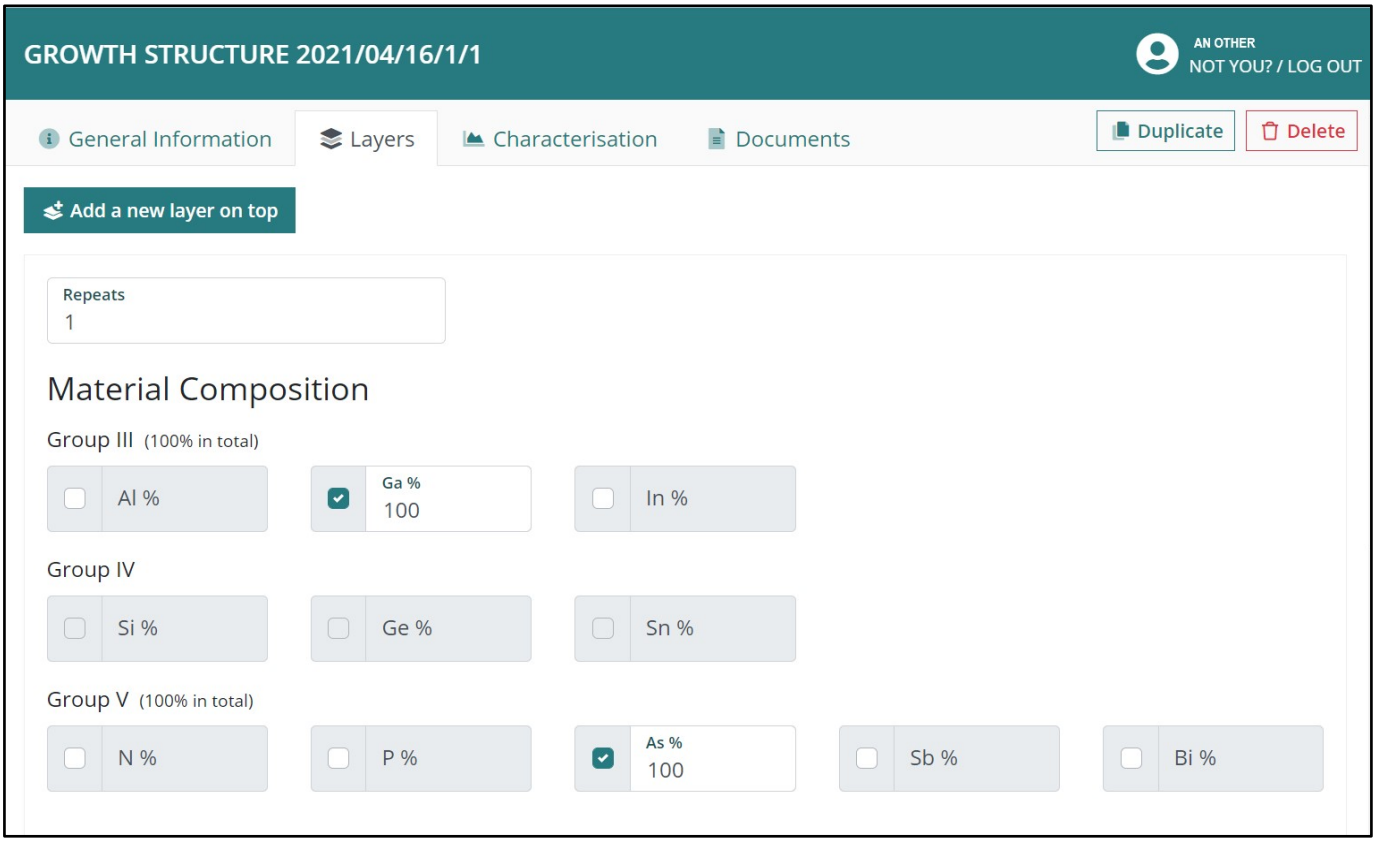

Figure 7 – Selecting the group elements and their composition percentages

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.

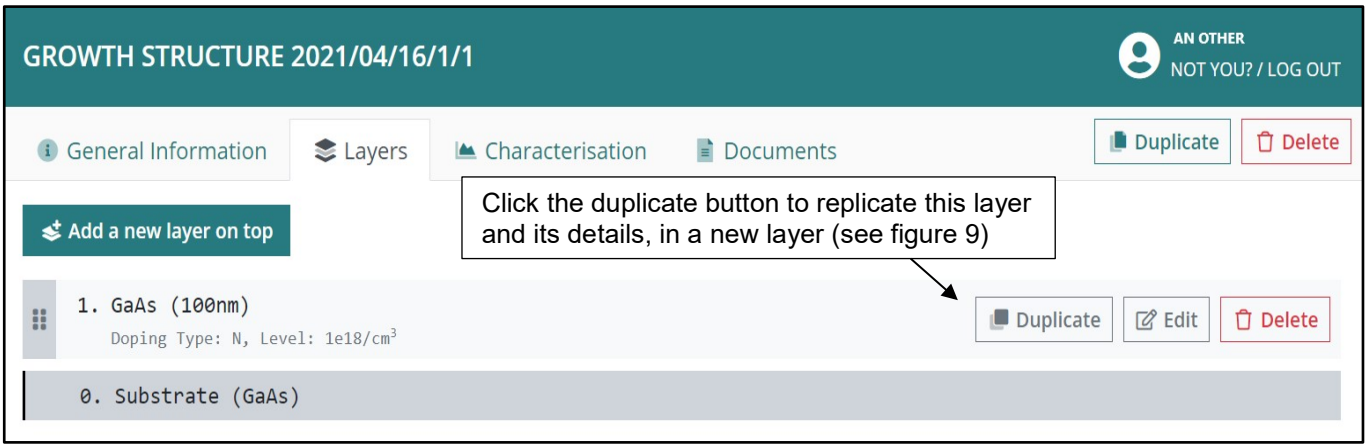

Figure 8 – Confirmed layer with details displayed

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.

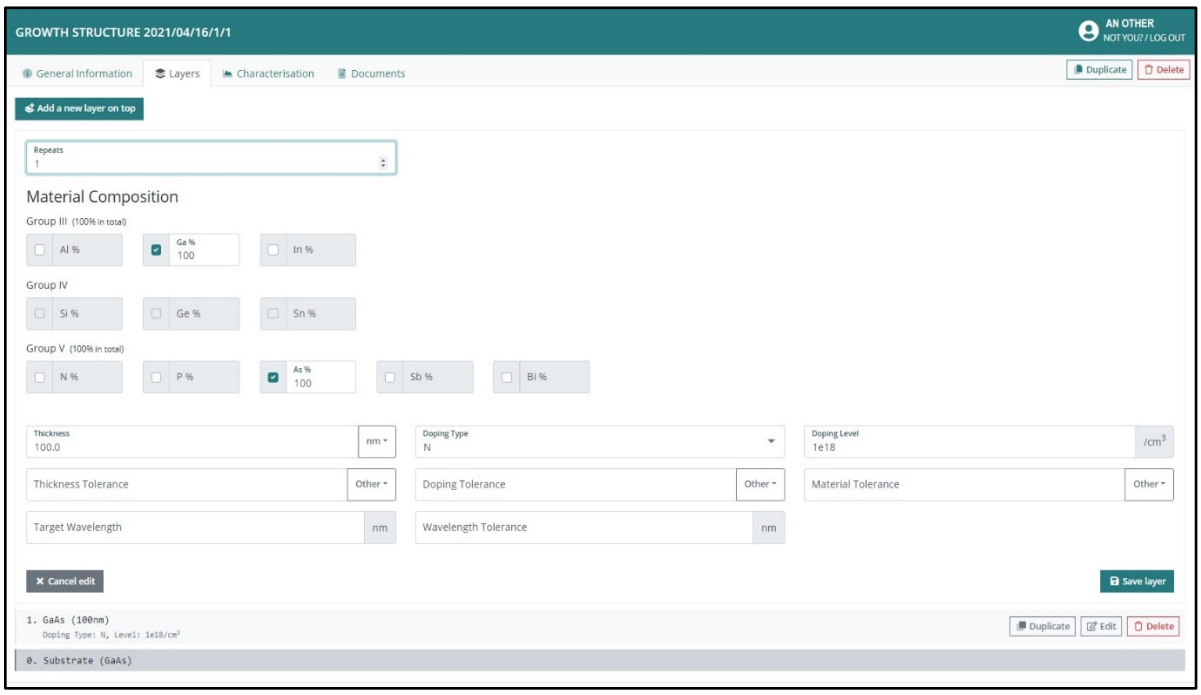

Figure 9 – Layer edit page generated by ‘Added layer’ or ‘Duplicate layer’ functions

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**.

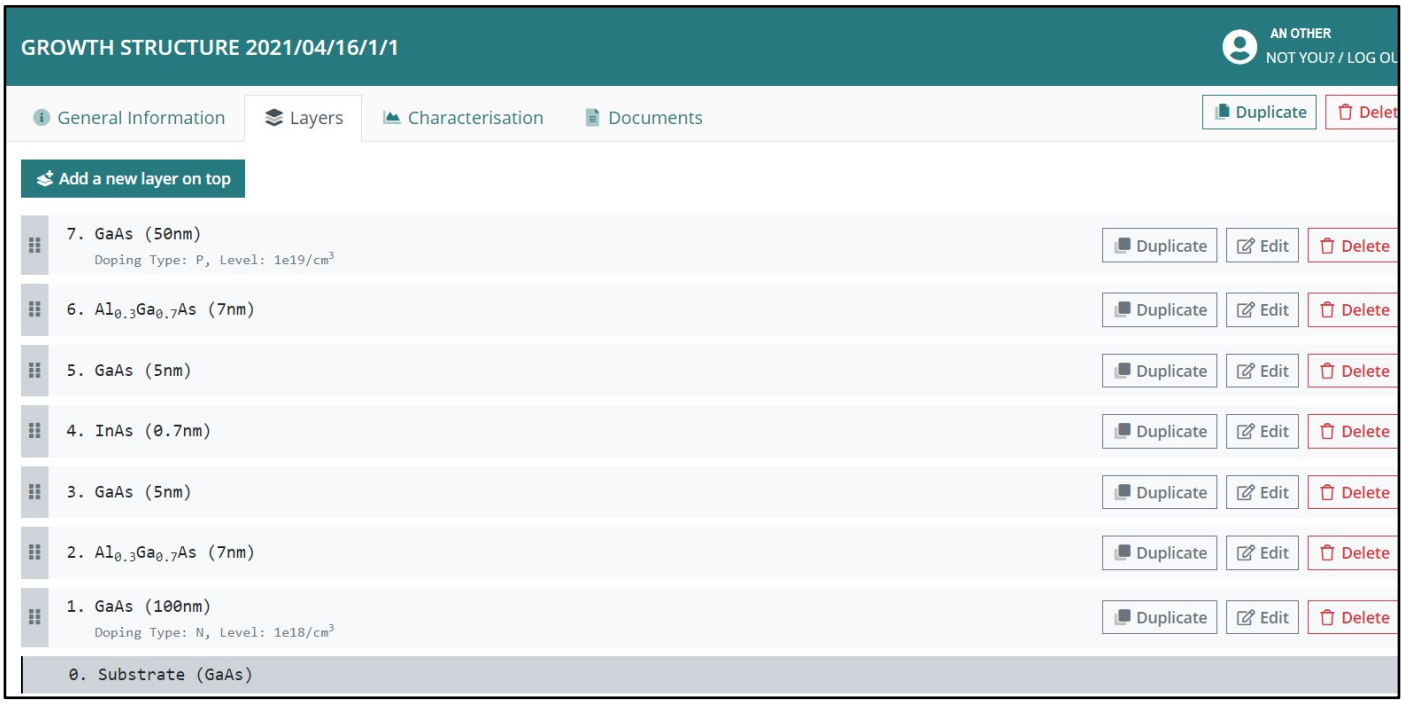

Figure 10 – Completed layer structure

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.

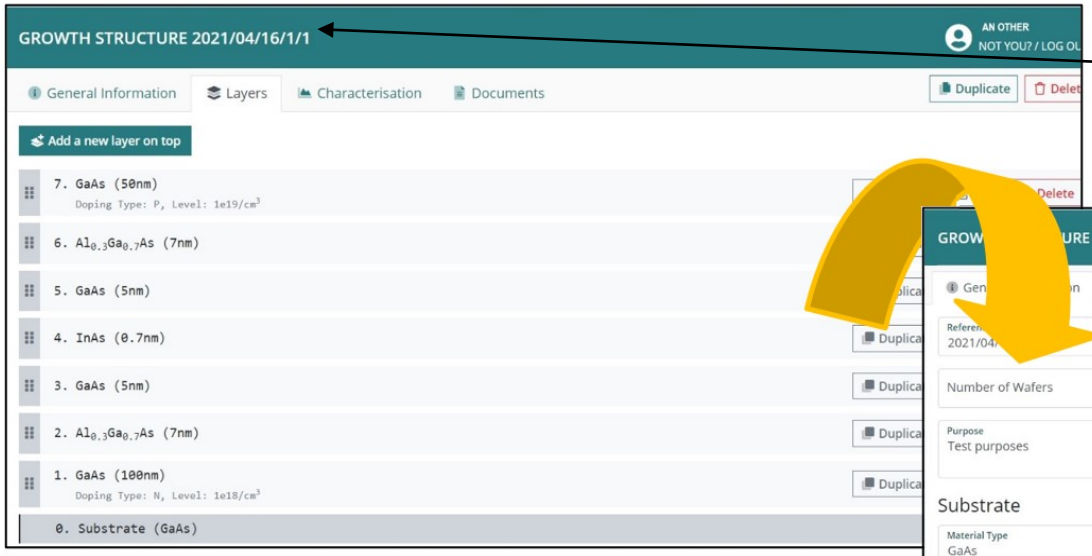

Figure 11a

Clicking the top Duplicate button copies the entire request **2021/04/16/1/1**. Generating a new request **2021/04/16/1/2** and opens the new one in the substrate page

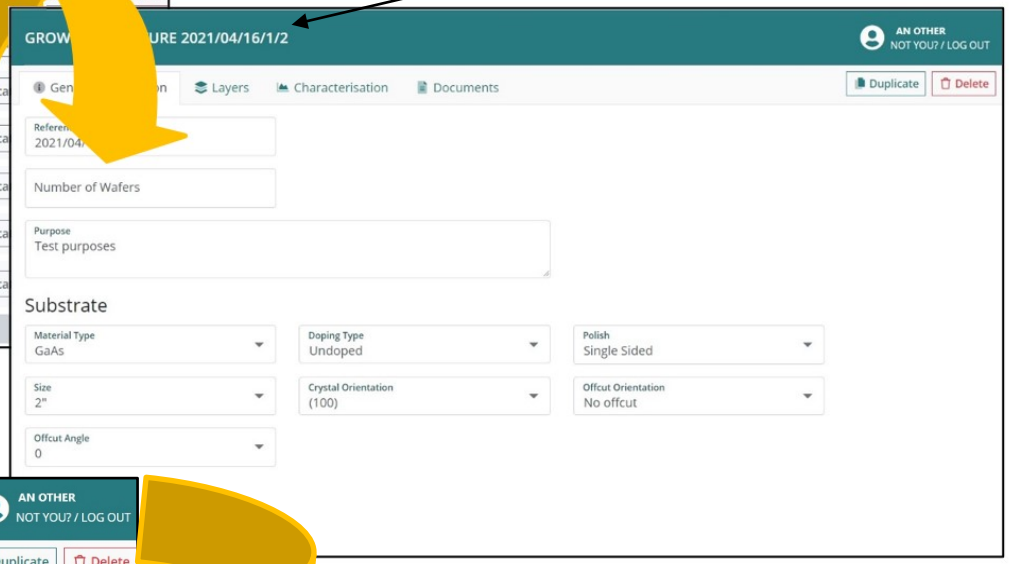

Figure 11b

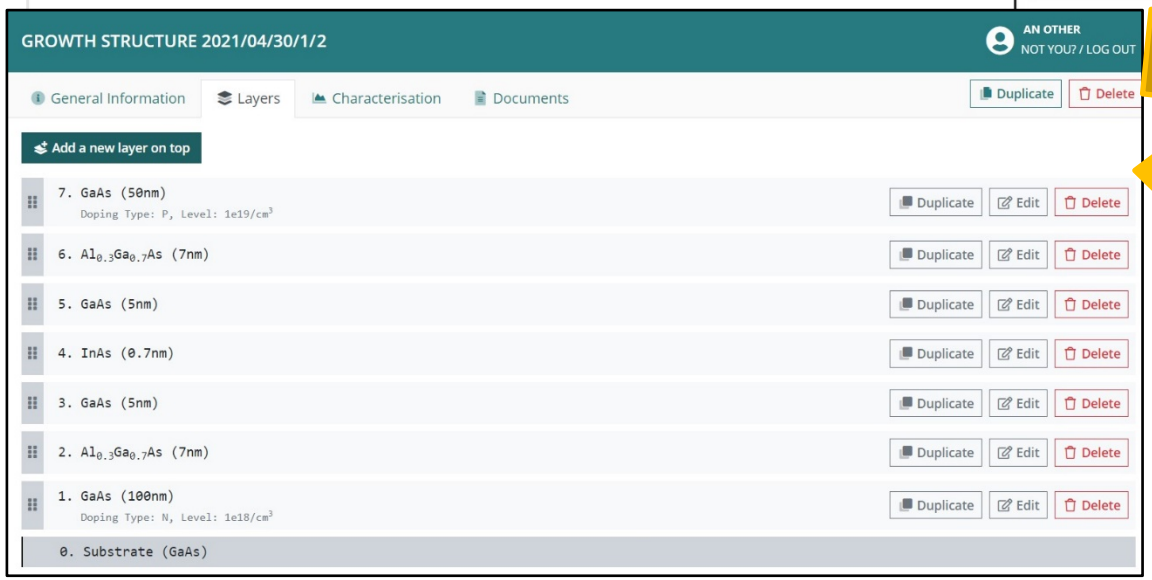

Figure 11c

From the new substrate page the layer page can be opened, showing the that the layers have been copied over to the new request.

Clicking on the individual layer edit buttons the layers can be altered as desired.

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).

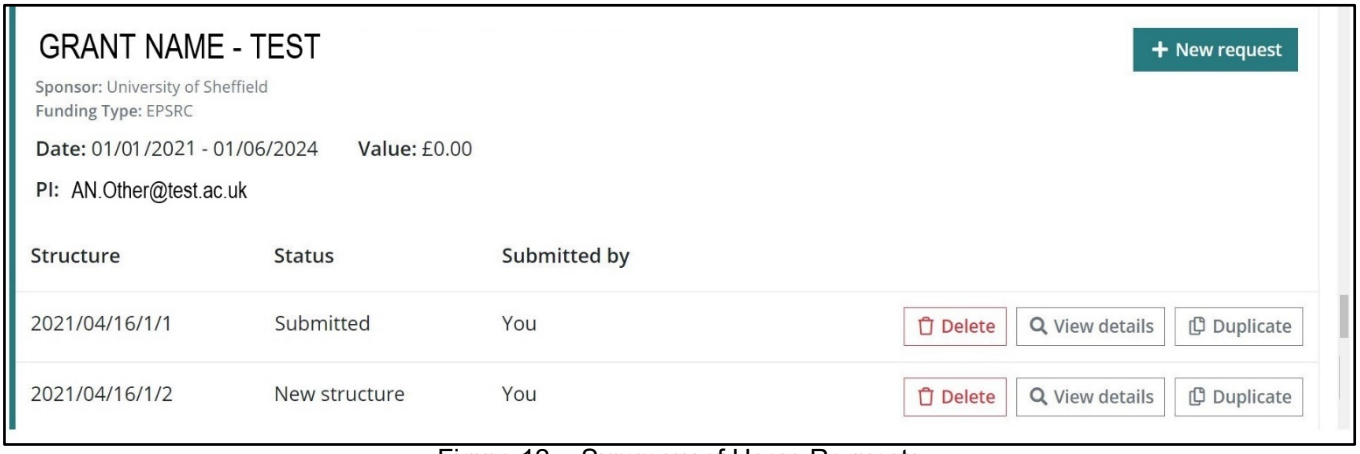

Figure 12 - Summary of Users Requests

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.

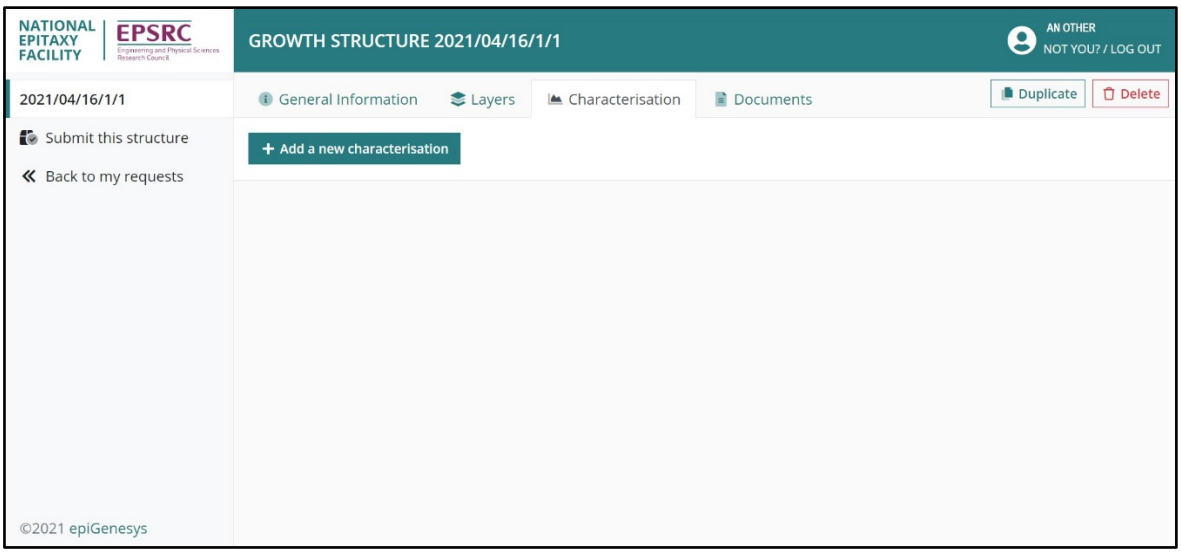

Figure 13 – The characterisation page

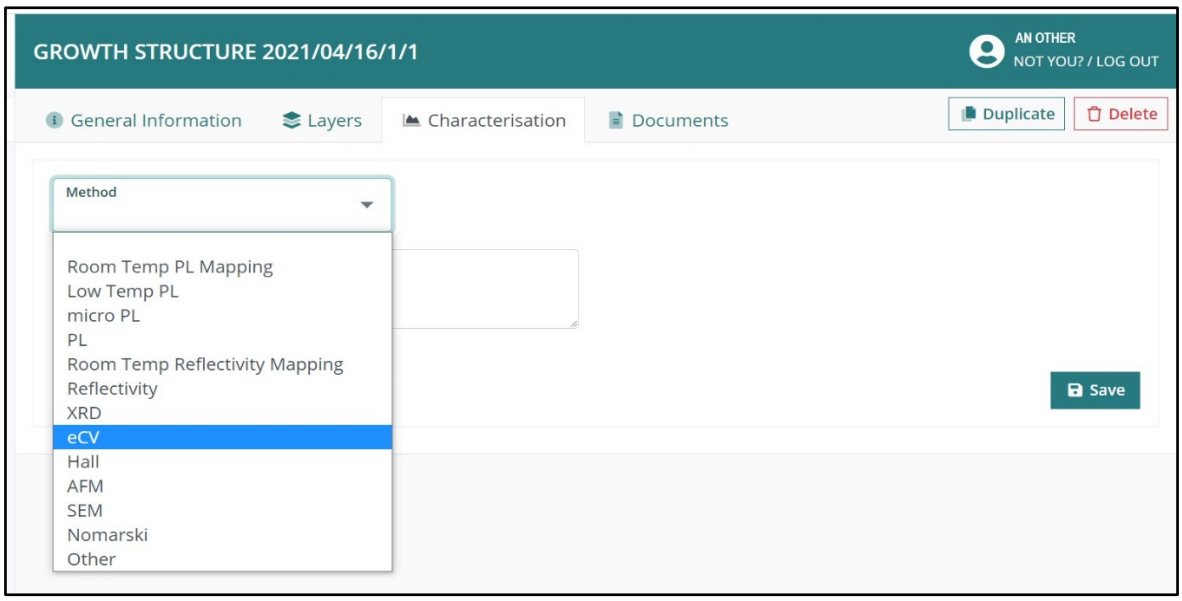

Figure 14 - Selecting a characterisation option from the drop down menu

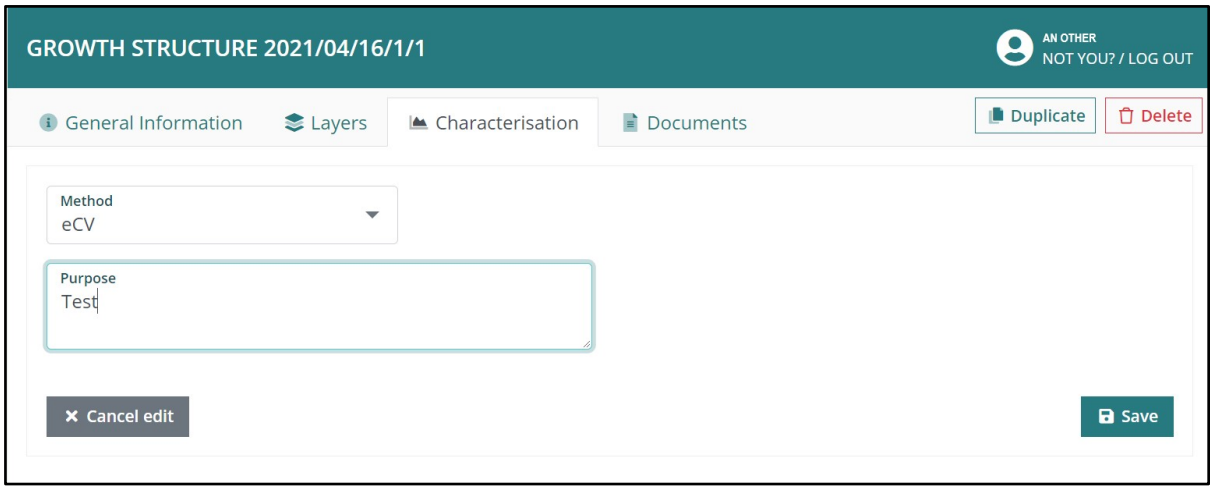

Figure 15 - Stating the purpose of the characterisation task

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).

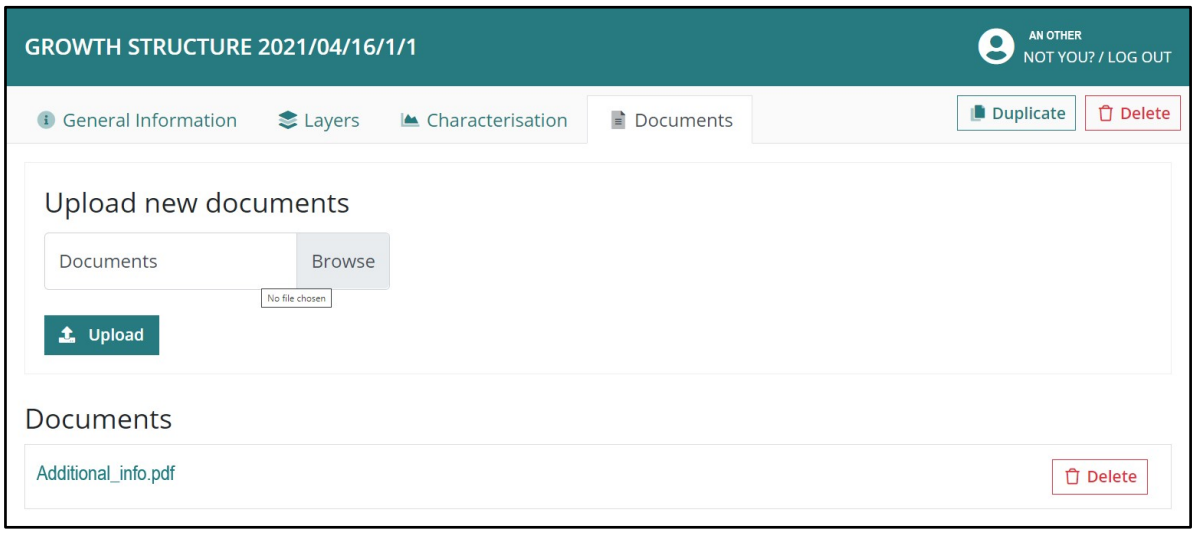

Figure 16 – showing a document has been uploaded to the request

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