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Magnetron Sputtering Explorer14 standard operating procedure

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Summary/Description
Explorer14 standard operating procedure

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Standard Operating Procedure (SOP)
Explorer 14 Magnetron Sputterer
(PVD-05)

In case of emergency please call 911
For any other major safety concern contact EHRS at: 215-898-4453 or via email: ehrs@ehrs.upenn.edu

If there is an error on the system/tool please report it on IRIS, we will take care of it

Please DO NOT run diagnosis without a staff member’s approval

General safety tips and common mistakes

1) Make sure that you are logged into the tool on IRIS before use. If you do not logg in, you cannot run the tool.
2) Make sure that you can log out after the pumping recipe is completed. If you logout during pumping down, warning sound will ring out.
3) The maximum power: DC 600 W (Theoretically, 707 W)
   RF 200 W (236 W, if you apply more power than this, a power supply is broken)
4) The targets provided: ITO, Cr, Ti, Ni, Cu, Al, SiO2, Ge, Pt, Au, Ag, Pd, Si, Al2O3, Mo, Te, and V.
   If you do not find the target you need, please let the staff know it.
5) Ag target must be cooled down for more than 15 min in vacuum after depositing an Ag film.
6) An oxide target, e.g. ITO, often suffers from cracking when the power more than 150 W is applied.
Explorer 14 Magnetron Sputterer

Procedure Overview

1) Check-in
2) Vent the chamber
3) Load samples
4) Pump down the chamber
5) Run a recipe
   5.1 Automatic operation
   5.2 Create a deposition recipe
   5.3 How to save the created recipe
6) Vent the chamber
7) Pump down the chamber-Stand by
8) Check-out
1. Check-in
   1.1. Login Explorer14 on the scheduler of the IRIS system before use.

2. Vent the Chamber
   2.1. Click "Recipe" on the bottom of the overview screen to open Recipe screen.
   2.2. Click "Edit/Create" in Master Recipe box to open Master Recipe Builder window.
   2.3. Click "Open" to open list of recipes. Make sure that "Auto Pump" is shown under Sequence Type.
   2.4. Choose "A_Vent.dat", and click "Open".
2.5. Click "Download" in Master Recipe Builder window. Make sure that the name in Active Recipe on the upper left corner of the screen is "A_Vent.dat".

2.6. Click "Close" in Master Recipe Builder window.

2.7. Click "Overview" to go back to Overview screen.

2.8. Make sure that "Auto" in System Control in Overview screen is highlighted. If not, click "Auto". In addition, Recipe name should be "A_Vent.dat".

2.9. Click "Start", so that the venting recipe starts.
3. **Load Sample**
   3.1. Open the chamber after the venting procedure (As the chamber comes to atmosphere, there will be a gas purge, when the door can open the gas flow will sound similar to the wet bench N2 guns).
   3.2. Place your sample on the rotatable stage. *) You sample(s) should be beneath the target. If the targets are in a confocal configuration, the sample should be in the center.
   3.3. Close the chamber door and latch the handle.

4. **Pump down the chamber**
   4.1. Follow steps 2.1 to 2.3 and select “A_Pump.dat”

5. **Run a recipe**

   5.1. **Automatic operation**

   5.1.1. Choose the recipe from list of recipes in Master Recipe Builder directory, like A_VENT.dat file in the above venting procedure.

   5.1.2. Make sure that the active recipe in the Recipe
screen is the recipe you choose.

5.1.3. Go to Overview screen, then click "start".

5.2. Create the deposition recipe

5.2.1. Go to the recipe screen.
5.2.2. Click "Edit/Create" on Deposition/T Steps to open the time-step configuration excel sheet. This procedure sets up the deposition sequences in the recipe.
5.2.3. Type the parameters in the time-step configuration excel sheet and then save the sheet.

**Step Time (sec):** Sets the duration (process time) of that step.

**Minimum Vacuum Setpoint:** MUST be reached before this step will execute.

**Gas (PID or Fixed) control:**
You can set up either of Gas pressure constant mode (PID) or fixed gas flow mode.
**PID mode**: Master Gas select should be 1 (Argon). The pressure is set up in **Gas PID Pressure**.

**Gas 1-setpoint (Ar)**: some number must be put in for activation, for example, 10. This does not mean 10 ppm.

**Gas 2-setpoint (O2)**: Blank

Example 1. PID mode: Cathode 1, pre-sputtering, DC 100W, 180 sec; deposition, DC 450 W, 120 sec; Ar 3 mTorr
**Fixed gas flow mode:**
Master Gas select should be 1 (Argon). 2 is for oxygen. You cannot set up the pressure.

**Gas 1-setpoint (Ar):** this number is actually a fix Ar gas flow (ppm).

**Gas 2-setpoint (O₂):** Blank

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**Reactive Sputtering Mode**
(Mixed gas mode)

The "PID Master Gas Select" should be 1 (Ar).

The Gas 1 Setpoint must be 100, while the Gas 2 setpoint must be chosen less than 100. For example, the setting that the Gas 1 setpoint is 100, while the Gas setpoint 50 means Ar gas is 50 %, while O₂ gas is 50 %.

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**Example 2:** Fixed gas mode: Cathode 1; pre-sputtering, DC 100W, 60 sec; deposition, DC 450 W, 120 sec; Ar 10 sccm

**Example 3:** Reactive sputtering mode: Cathode 1; pre-sputtering, DC 100W, 60 sec; deposition, DC 450 W, 120 sec; flow rate ratio: Ar:O₂ = 80:20; Ar pressure, 3mTorr
Other parameters:
Source power settings (RF or DC, for target 1 or 2):

**Sputter**: Pre-sputter power to clean the target

**Cathode Select**: Sputtering power setting for operation of the cathode.

**Shutter**: Open or Close (Blank)

**Ignition Pressure**: Must be set up if the RF cathode requires a higher pressure to ignite than obtained with the selected flow.

**Rotation Speed**: 100% = 18-20 rpm.

**End Process**: Must select "Yes".

**Insert Column**: insert a column before the column selected.
**Delete Column**: delete the active column.

5.3. How to save the created recipe.

5.3.1. When the recipe is created on the excel file, the recipe is saved, using “Saved As” button on the excel file. The excel file is closed.
5.3.2. Click the “Edit/Create” button in the Master Recipe box.
5.3.3. Choose “Auto Deposition” in Sequence Type box, and Choose your recipe created in “User Defined Sequences”.
5.3.4. Click “<Add” button.
5.3.5. Click “Download”.
5.3.6. “Please Save Master Recipe” window appears.
5.3.7. Save your created recipe.
5.3.8. Active recipe becomes your created recipe.
5.3.9. Click “Start” in the Overview screen.

*This procedure is required only for the recipe created. However, open the recipe from “Please Save Master Recipe” window directly from now on.
### 6. Vent the chamber

6.1. Follow the steps outlined in "**2. Vent the chamber**".
6.2. Open the chamber, and take out your sample.
6.3. Vacuum-clean the inside of the chamber. Wipe-off with IPA, if necessary.
6.4. Close the chamber.

### 7. Pump down the chamber-Stand by

7.1.1. Follow the steps outlined in "**4. Pump down the chamber**".

### 8. Check-out

8.1.1. Log out of the ISIS system after the pumping is done.

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Feel free to contact the staff members with any questions about your process and the tool.

Last modified: 10/29/2021 by Hiromichi Yamamoto