

# DTSA II Tutorial 1: Setting Up Your Detector

## Introduction

Because so much of DTSA II relies on the parameters of a user's X-ray detector, the first step to using DTSA II should be setting up a default detector and instrument. Doing so allows the user to more accurately simulate spectra, quantify data and use the detector calibration functions.

In this tutorial, the user will learn to:

- Create a new instrument
- Create a new detector
  - Apply parameters to the detector such as window type, detector thickness, orientation and starting calibration.
- Apply command line tasks in order to call up detector efficiency, window transmission, and delete detector settings

## The DTSA II Screen

The screenshot shows the 'DTSA II - Preferences' dialog box. On the left is a 'Preferences tree' with a green box label. The main area is titled 'Detector - EDAX 6.4us'. It contains several sections: 'Status' with an 'Enable detector' checkbox checked; 'Name' with a 'Detector name' input field containing 'EDAX 6.4us'; 'Import' with an 'Import from spectrum' button; 'Window' with a dropdown menu set to 'Beryllium (25 μm)'; and 'Position' with an 'Elevation angle' input field set to '60.0 °'. A scroll bar is visible on the right side of the main area. At the bottom are 'OK', 'Cancel', and 'Apply' buttons. Three green boxes with arrows point to specific elements: 'Detector name input box' points to the 'Detector name' field; 'Window type input box' points to the 'Window' dropdown; and 'Other detector parameters (scroll down to review)' points to the scroll bar.

## Setting Up an Instrument and Detector

After starting DTSA II, select **File / Preferences** to open the preferences window. Click on the **Instruments and Detectors** folder to create an instrument. Note that you must create an instrument before you can create a detector. To create an instrument, simply click the **Add** button.



You will be prompted to name the instrument. This is the only parameter required to establish an instrument. Depending on the type of detector attached to the instrument, click the **Add Si(Li) detector** or the **Add SDD detector** button to create a new detector.

To add new detectors to already created instruments, click on the instrument name in the preferences tree. Then click the corresponding button to the type of detector to be added.

## Changing Detector Parameters

Once a detector button has been pressed, DTSA II will create the detector with a series of default parameters. Click on the detector in the preferences tree to change the detector parameters. The parameters appear on a scrollable list on the right side of the preferences window.

While it may be difficult to find certain values, such as crystal parameters and sample to detector distance, it is extremely important that such factors be listed correctly so as to ensure accurate simulation and quantification.

After the detector options have been selected, click the **Apply** button at the bottom of the screen to save the changes, and then click **OK** to exit.

## *Importing Spectrometer Parameters from a Spectrum*

Many spectra, including those in the MSA format include a number of detector parameters in the file header. DTSA II can read those detector parameters and fill in the appropriate values. When selected, the parameters whose input boxes are colored in yellow have been changed by importing the spectrum.

## ***Setting an Initial Resolution***

In the detector parameters window, under the sub-heading **Base Performance**, there are input boxes for energy scale, zero offset and resolution at Mn K $\alpha$ .

These parameters indicate base performance only, and should be adjusted by calibrating the detector through the DTSA II calibration alien. However, it is important that the values be close to the actual performance of the detector, since *DTSA II uses the specified values as the initial approximation for detector calibration*. If, for instance, a user specifies that the energy scale is 5 eV/channel, and the actual performance is 10 eV/channel, the calibration alien will likely fail to converge on a solution.

## ***Changing Detector Parameters after the Initial Setup***

Once the detector has been saved, a user can return later to change most of the detector parameters. However, the parameters set by the calibration alien (e.g. energy scale, zero offset and resolution) cannot be set again by the user. Those boxes are grayed out. Should the user make a mistake, such as setting the energy scale at 5 eV instead of 10 eV, the best course of action is to delete the problem detector and add a new one. See Troubleshooting and Comments at the end of this tutorial for instructions on how to delete detectors.

## Command Line Functions

A brief description is laid out for some command line functions of interest to the user regarding detector properties. Syntax examples are included in { } brackets.

Command	Syntax	Comments
listDetectors()	listDetectors([])	Returns the detector list with the name designate of each detector. In the command line, each detector is listed as d# (d1, d2, ...dn).
getEfficiency().display()	getEfficiency([detector]).display() {getEfficiency(d1).display()}	Use the d# designation to select the detector. This command will return a spectrum with the % Detection Efficiency of a detector with given characteristics.
windowTransmission().display()	windowTransmission([detector]) {windowTransmission(d2)}	Again, use the d# designation to see the transmission of X-rays through the detector window.

## Troubleshooting and Comments

Often, the values necessary for proper simulation and quantification are difficult to find. Many instrument manufacturers include a series of CAD drawings showing detector geometry. It is important to note that the sample to detector distance is not the distance from the end of the EDS detector snout to the sample center point. Taking into account collimators, detector windows and electron backscatter traps, the detector is often a few millimeters from the edge of the snout.

Also, it is important to note that the crystal parameters are recorded in mixed units. Detector area is listed in square millimeters (mm<sup>2</sup>), the thickness of the gold and aluminum layers are recorded in nanometers (nm), and the thickness of the dead layer is recorded in micrometers (µm). *Many manufacturers list this value in nanometers* (a common value being 80 nm).

Deleting problem detectors or detectors that are not in use should be done carefully. When a detector is deleted, all of the spectra, calibration information

and database information are deleted along with it. The command and syntax are as follows:

```
dtsa2.DTSA2.getSession().deleteDetector([detector])
```

Note that DTSA II uses the d# designation for detectors (d1, d2, ..., dn), not the detector name as listed in other windows.

## **Cheat Sheet for Tutorial 1**

### **Set up new instrument**

File / Preferences / Instruments and Detectors / Add

### **Set up new detector**

File / Preferences / Instruments and Detectors / [Instrument Name]  
/ Add [Si(Li) or SDD] / [Change Parameters] / Apply

### **List Detectors (Command Line)**

```
listDetectors()
```

### **Get Detector Efficiency (Command Line)**

```
getEfficiency([d1]).display()
```