Auger HowTo for the SEXAFS CMA 100

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Contents

List of Figures

1 The device

On the main vacuum vessel the Cylindrical Mirror Analyser CMA100 from Omicron Gmbh is installed right in front of the x-ray beam entrance. You can easily locate it, since it is above the metallic plate used to climb on the top of the vessel.

The CMA100 have a NGE52 5kV e-gun integrated.

A computer is connected through a SCSI cable to the DT300 interface box and from this to the Auger control unit.

Computer, Auger control unit and NGE52 e-gun control unit are usually close, since only the data collection is achieved through the computer, the control

of CMA and e-gun is exclusively performed through the front of their control units.

A weel driven linear motion is integrated to the CMA to set the correct focus and distance to sample.

2 Important warnings

2.1 Collisions

The CMA may collide with the sample holder. To prevent this act as following.

1. Retract completely the fluorescence detector, put the big spacer in place and then close its gate valve. NEVER skip this point.

2. Verify that the Auger unit is fully backward before approaching sample and before moving the sample away.

3. Put the sample at the position specified in the document "Sample Holder Positions" contained in the SEXAFS handbook. That document is usually updated regularly.

4. Observe the CMA approaching the sample through the video camera or through one of the large viewports.

5. Coming back from the Auger to the sputtering gun, please, move z first, the other movements later. This will considerable reduce the risk of collisitions.

2.2 Voltage

The e-gun can work from 100 to 5keV, but at 5keV the unit can suffer discharges and abruptly stop working. The user is strongly encouraged to limit the voltage to 3kV for Auger spectra collection and to never go above 4.5kV.

High voltage on the CMA should be raised slowly and meet, but do not exceed, that specified in this document. Original values in the instrument handbook correspond to a new channeltron. With ageing those values must be increased, but too large values will reduce its lifetime.

2.3 Surface contamination

The e-gun can produce a large amount of C and O contamination over the surface for very long exposures. If you need to acquire spectra overnight, degas the gun for at least 12 hours at $I_F \approx 2.37$mA and then reduce it at about 2.22mA to obtain $I_0 \approx 5$ţA or less.

Normal working conditions are $I_F \approx 2.35$ mA and $I_0 \approx 5$ţA.

3 Recording an Auger spectrum

3.1 Quick and dirty method

1. Move the sample to the position specified in "Sample Holder Positions" document.

2. Advance the CMA completely, while verifying that no collisions occur. Move it back until the silver stripe is in front of zero.

3. Turn on the e-gun NGE52:

   (a) HV on; Beam ON; Monitor Voltage;
   (b) set the voltage to 3000V.
   (c) Monitor I_0 on the left and filament current on the right.
   (d) Rotate the filament control potentiometer to obtain $I_F \approx 2.35$A.
   (e) Wait for the beam to stabilise for about 5 minutes, then adjust I_F to obtain $I_0 \approx 5$μA.

4. Turn on the Auger Control Unit:

   (a) HV on; Monitor high voltage, not energy or analyser voltage;
   (b) turn slowly the potentiometer to set the high voltage to 1000V.

5. Log in the computer as user "sexafs" with password "sexafs";

6. start program DatAuger (from lower bar or desktop). Warning: if another instance of the program is already running, you won't be able to acquire data.

7. Select one and only one of the predefined scans on the right side of the screen by checking its box. If you select more than one, they will be executed one after the other. To start with, use the "Copper" scan.

8. Press the RUN button on the toolbar.

9. To change the scan settings as the gain of the lock-in amplifier you must enter in the Set-up menu, chose the scan item: a window will open. In the new window chose the tab you need.

   (a) Energy range.
   (b) Dwell time (Must be three time the lock-in constant! chose one accordingly to the other).
   (c) Lock-in amplifier:

Sensitivity =300μV	Amplitude=5V	Phase=252ř
Time constant=300ms	Frequency=F	9.5kHz CMA
($\Rightarrow$Dwell Time=900ms)	Low drift	

10. To save the file, activate the graphic window with the acquired spectrum, then go to the File menu item and chose save as.

3.2 Improving data quality (expert users)

If you suspect that the resolution is not good enough, that peaks are strongly shifted or deformed, you can follow a part or all of the following procedure.
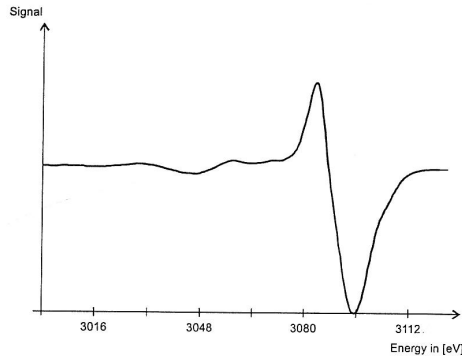
Figure 1: Differentiated signal of the elastic peak (CMA 100). Primary electron energy =3keV, modulation amplitude of oscillator 5 V_{pp}, peak width according to the extrema in the differentiated peak: (FWHM) 11.5 eV/3000 eV=0.4%.

3.2.1 Finding and optimising the elastic peak

1. Follow the start-up procedure described in 3.1 until point 6.

2. Set the CMA high voltage to **900V**.

3. In the menu **Setup** choose **Fast scan**.

4. Set the lockin amplifier as follow :

Sensitivity =10mV	Amplitude=5V	Phase=252ř
Time constant=30ms	Frequency=F	9.5kHz CMA
($\Rightarrow$Dwell Time=90ms)	Low drift	Energy: 2950-3100

5. The elastic peack should appear, you can play with several parameters. Only the first parameter should be enough, actually. A "perfect" peak is represented in Figure 1.

    (a) CMA position. Adjust it to set the peak at the focus position and obtain a finer peak.

    (b) X and Y should be already set, but if you see a peak split in several sub peaks or with a bad simmetry you could play with these values. Do not erase the reference pencil marks on the controller, please, even if you think your setup is better.

    (c) Play with focus between 7 and 8 to obtain a finer peak with a positive part on the lower energy side.

3.2.2 Optimising the signal

Set the MCA voltage to 1000V. Record a spectrum of your sample and if the energy of the peaks is shifted, play with the sample distance again. Once satisfied, you should iterate the optimisation of the elastic peak as described in 3.2.1. Before, set the MCA voltage down to 900V.

You can cumulate several scans to increase signal to noise ratio: open the menu **Setup**, select **Scan** and find the box number of scans. You will be able to stop the scan at any number of scans and obtain a correctly averaged spectrum.
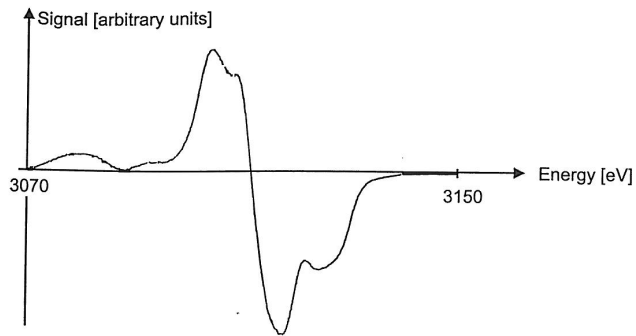
4

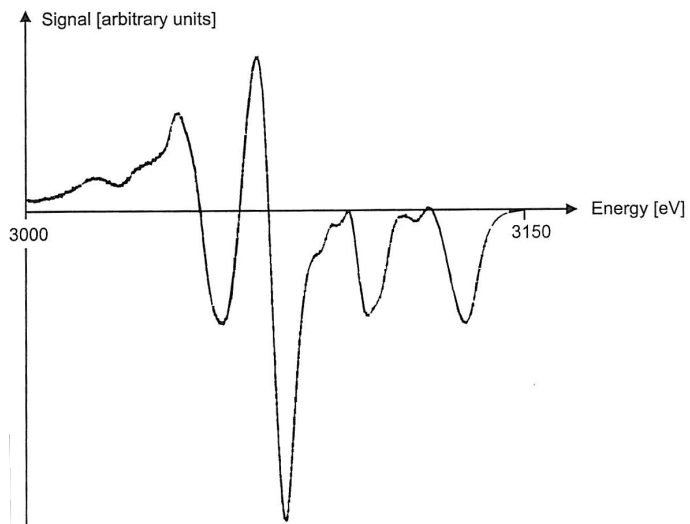Figure 2: Differentiated signal of the elastic peak, sample 2.5 mm out of focus.

Figure 3: Differentiated signal of the elastic peak, XY-deflection not optimised.