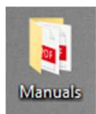# XPS2 Reflected Electron Energy Loss Spectroscopy (REELS) Operating Procedure

Reflected Energy Loss Spectroscopy (REELS) operates by using the Flood Gun to fire a beam of electrons at the sample surface, and measuring the kinetic energy of the scattered electrons. It provides valence electronic information from a similar range of depths as XPS (0-10nm) and in some cases can also detect Hydrogen, which XPS cannot. REELS is ideal of the analysis of metal oxides, semiconductor films, or organic materials with conjugated bonding configurations. For example, it can measure the band gap of a metal oxide or the relative energies of the lowest unoccupied energies in an OLED material.

Help Resources

XPS knowledge viewer – Complementary Techniques – REELS (Reflected Electron Energy Loss Spectroscopy)
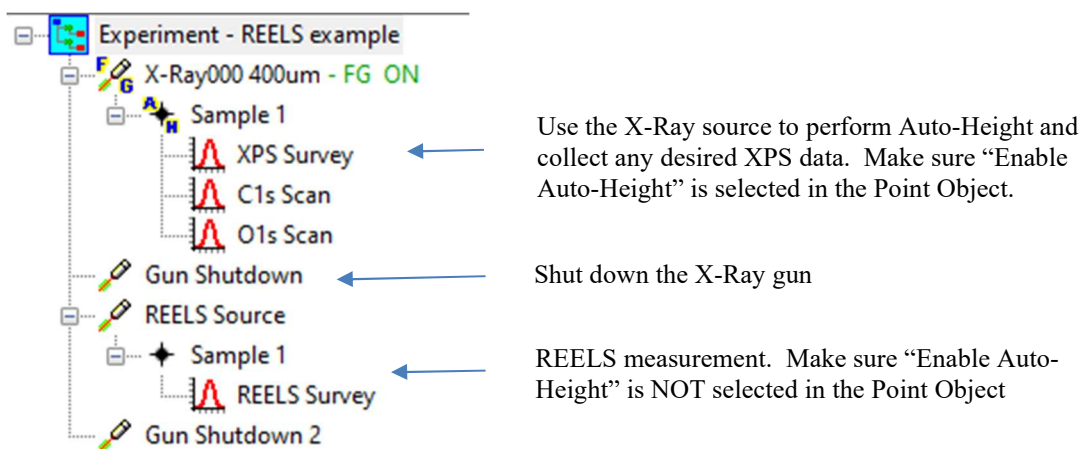
Nexsa G2 User Manual (page 96) provided by Thermo Scientific is located in the Manuals folder on the desktop

Important Notes

- REELS uses the Flood Gun as the electron source, and the beam size is about 2mm in diameter
- As REELS relies on detecting scattered electrons, it is important to turn off the X-ray source when collecting REELS data
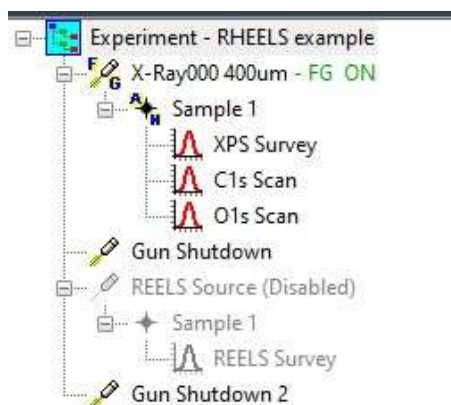
Procedure

An example REELS experiment is shown below

Use the X-Ray source to perform Auto-Height and collect any desired XPS data. Make sure "Enable Auto-Height" is selected in the Point Object.

Shut down the X-Ray gun

REELS measurement. Make sure "Enable Auto-Height" is NOT selected in the Point Object

Perform an XPS measurement to find the optimum sample height and to collect any desired XPS data

1. Set up an XPS run to perform Auto-Height and collect any desired XPS data. Make sure "Enable Auto-Height" is selected in the Point Object

2. Insert a Gun Shutdown step to turn off the X-Ray gun
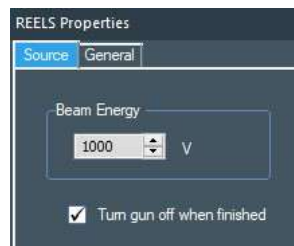3. Disable the REELS portion of the Experiment

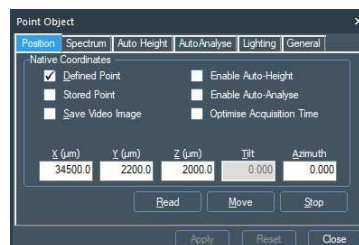4. Start experiment by clicking on the green arrow
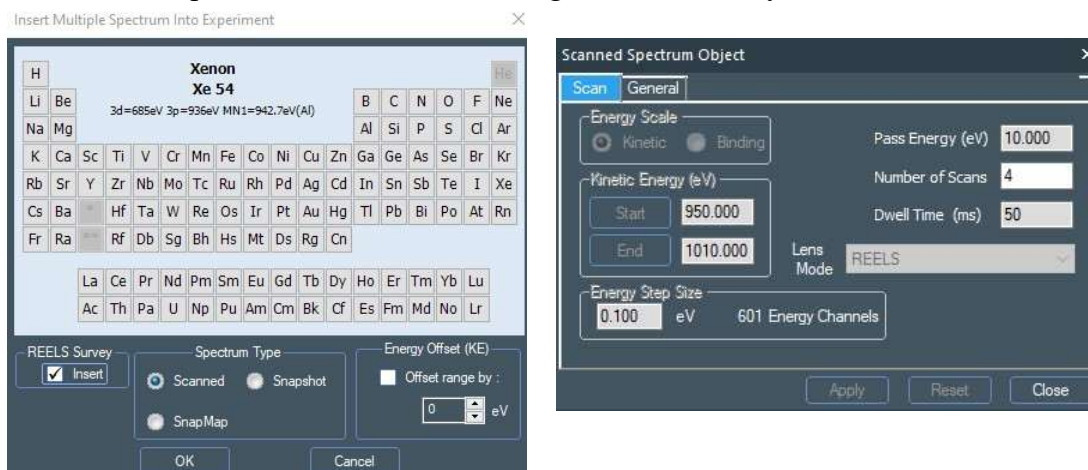
Perform a REELS measurement

5. Create a REELS measurement Experiment
   1. Select the REELS source from the Source menu. Standard beam energy is 1000V, and select "Turn off gun when finished"

   2. For the measurement location, use the same POINT coordinates that were used for the X-Ray Auto-Height. This can be done by copying the POINT step from the XPS portion of the Experiment and pasting it into the REELS portion of the Experiment. Make sure "Enable Auto-Height" is NOT selected in the Point Object
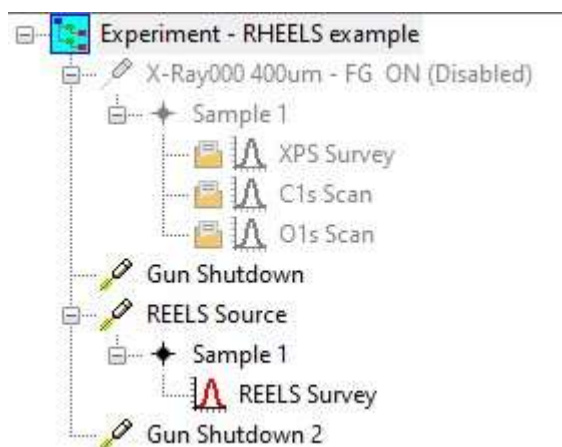
3. Add a REELS Survey by clicking on the Spectrum Icon, and then selecting "Multi Spectrum" , and then selecting "REELS Survey"

Default REELS Survey settings

6. Enable the REELS portion of the Experiment and Disable the XPS portion of the Experiment

7. Start experiment by clicking on the green arrow

Processing Data

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 The XPS knowledge viewer has guides for processing data in the Avantage software. See the section on Band Gap Measurement under "Non Linear Least Squares Fitting"

Band Gap Voltage Measurement
Note – the Band Gap Voltage measurement is not accurate for small band gap materials

An estimate of the band gap voltage may be obtained from a measurement of the onset of energy loss. The assumption is that the electrons will first lose energy to overcome the bandgap of the material before further inelastic energy loss is observed.

1. Select the Band Gap Voltage measurement icon

2. The recommended default parameters are shown below. However, these parameters may be adjusted.
3. The band gap is automatically calculated as the difference between the elastic scattering peak (zero energy loss) and the value where the slope of the onset of energy loss crosses the X axis.