

TM022 – Temperature stage accessory

WiRE™ 5

This document aims to show the inVia user how to set up and use Linkam temperature stages (e.g. THMS600, TS1500) in conjunction with the WiRE software. It assumes the user has read and understood the relevant temperature stage manual, and the appropriate software module has been installed.

Setting up the temperature stage

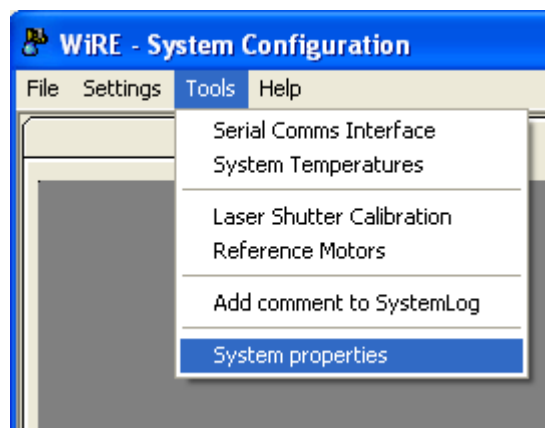
For information on how to set up the stage cooling please refer to the Linkam manual.

The temperature stage is connected to the PC by USB or serial cable, via a controller (e.g. T95), depending upon the number and type of ports available on the computer.

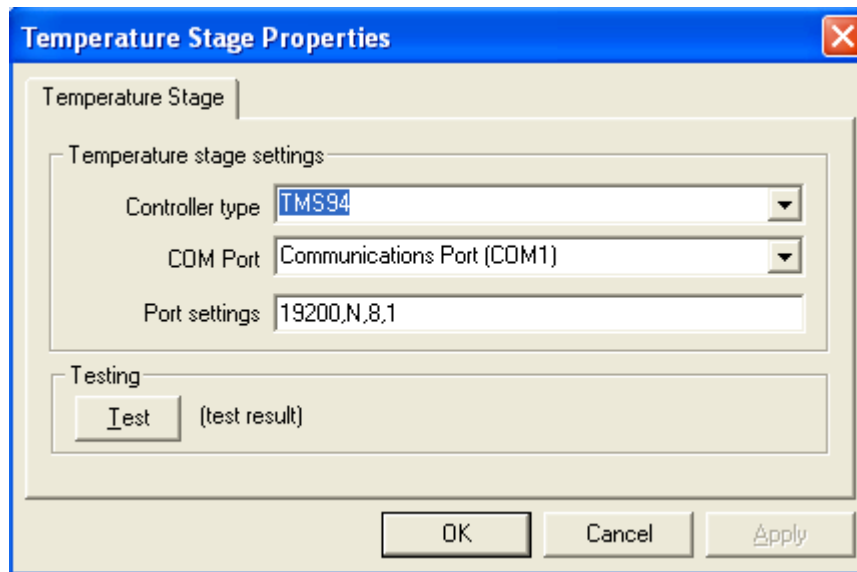
Place the temperature stage under the microscope. It is advisable to fix the temperature stage in place using suitable clamping equipment or the magnets provided in the HSES accessory pack.

Establishing the temperature stage connection

Select the **System properties** option from the **Tools** menu in **System configuration**.
(Accessed from **WiRE>Tools>System Configuration**)

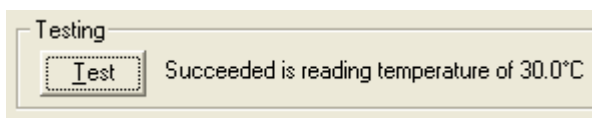


Select **TMS stage** button from options to open the **Temperature Stage Properties** window

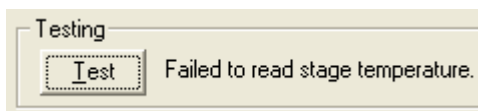


To add temperature stage using a USB or serial port

1. Connect USB or serial cable from TMS controller to an available PC port
2. Turn controller power on, select correct controller type
3. Select correct COM port
4. Click **Test** button



Successfully connected



Unsuccessful connected

If unsuccessful, it is likely that the COM port, or controller type is incorrectly selected, or the cable is not correctly connected to the PC. Check, and retry.

Setting up a measurement

The temperature control capabilities of WiRE are configured from two locations. Temperature series measurements are set up in the **Temperature** tab of the **Spectral acquisition setup** window. Additional control over the temperature stage during a measurement is enabled by the **Advanced temperature control (ATC)** application (opened from **Start>Renishaw WiRE 5.0>Tools>Advanced temperature control** prior to running a measurement.)

This document aims to guide the user through the operation of the temperature control options through guided scenarios. These assume a temperature stage has been set up as described above.

The first 3 scenarios assume pre-knowledge of sample behaviour with temperature, so do not include the ability to interact with the measurement after initiation. However, WiRE also allows the user to adapt the measurement once it has been started if desired, as described in scenarios 4 and 5.

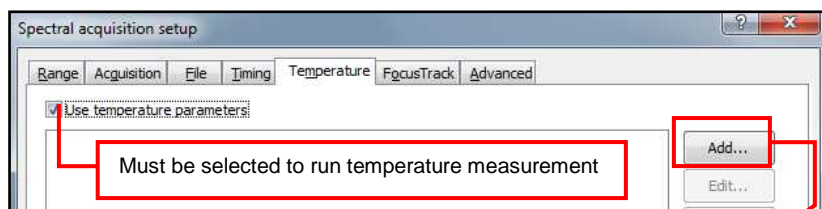
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ATC

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1. Ramp between two temperatures with data collection at start and/or end of ramp

- Temperature tab: Open the **Temperature** tab in the **Spectral acquisition setup** dialogue, and tick the **Use temperature parameters** box.



It is now possible to add a ramp stage by clicking the **Add...** button, which opens the **New ramp properties** window. From here, ramp and hold phases can be defined.

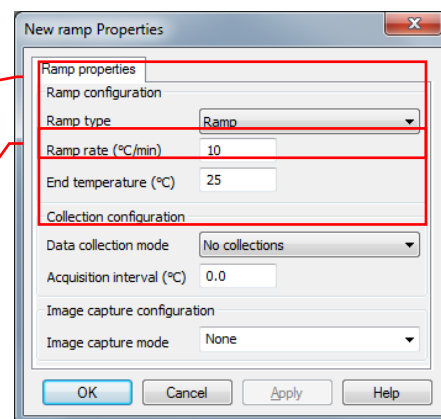
- Ramp to start temperature: It is advisable to create a ramp to the desired start position, as it is not possible to define a starting temperature in a single ramp phase. In the **New ramp properties** window, select **Ramp** in the **Ramp type** menu.

Select the desired **Ramp rate (°C/min)** and **End temperature (°C)** (in this case the start temperature for the next ramp).

Note: The ramp rate is an absolute value, so should be set as a positive number for heating and cooling.

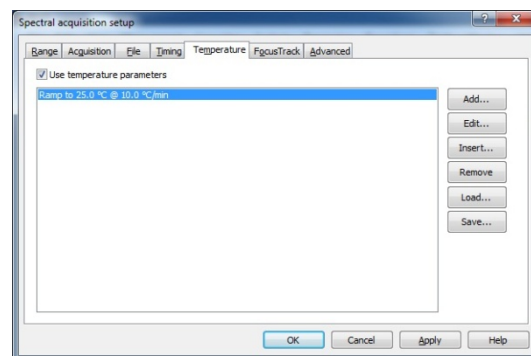
For this ramp, it is not necessary to alter the **Collection configuration** or **Image capture configuration**.

Click **OK**, the ramp is now displayed in the **Spectral acquisition setup** window.



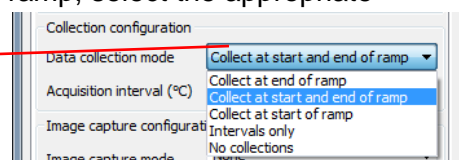
- Ramp for data collection: Click **Add...** again to add another ramp phase. (**Insert...** adds a ramp phase before the one selected, the other buttons are self-explanatory).

Set the **Ramp type**, **Ramp rate** and **End temperature** as desired (described above).



To collect spectra at the start and/or end of the temperature ramp, select the appropriate option under **Data collection mode**.

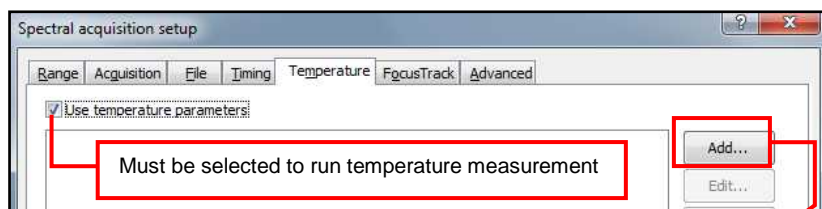
For the data collection only at the start and/or end of the ramp, set the **Acquisition interval (°C)** to 0.



- Run the measurement: Click **OK**, and ensure all experimental parameters in the other tabs of the **Spectral acquisition setup** window are appropriately configured. Click **OK**, and then click **Run** to start the measurement. This will collect spectra of your sample at the start and end temperatures, and hold the sample at the final temperature.

2. Ramp between two temperatures with data collection at intervals

- Temperature tab: Open the **Temperature** tab in the **Spectral acquisition setup** dialogue, and tick the **Use temperature parameters** box.



It is now possible to add a ramp stage by clicking the **Add...** button, which opens the **New ramp properties** window. From here, ramp and hold phases can be defined.

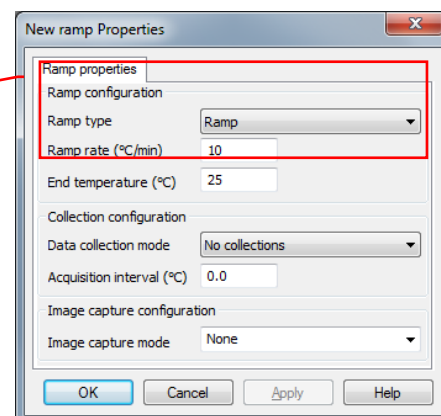
- Ramp to start temperature: it is advisable to create a ramp to the desired start position, as it is not possible to define a starting temperature in a single ramp phase. In the **New ramp properties** window, select **Ramp** in the **Ramp type** menu.

Select the desired **Ramp rate (°C/min)** and **End temperature (°C)** (in this case the start temperature for the next ramp.)

Note: The ramp rate is an absolute value, so should be set as a positive number for heating and cooling.

For this ramp, it is not necessary to alter the **Collection configuration** or **Image capture configuration**.

Click **OK** and the ramp is displayed in the **Spectral acquisition setup** window.

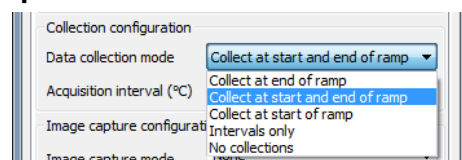
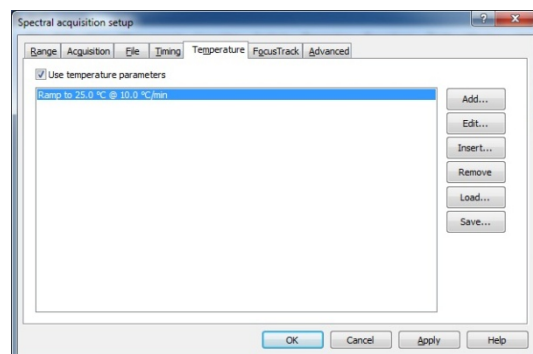


- Ramp for data collection: Click **Add...** again to add another ramp phase. (**Insert...** adds a ramp phase before the one selected, the other buttons are self-explanatory.)

Set the **Ramp type**, **Ramp rate** and **End temperature** as desired (described above).

Select **Collect at the start and end of the temperature ramp** under **Data collection mode**. Then set the **Acquisition interval** as required. This will collect spectra at the start, end, and at the defined intervals.

Note: The **Intervals only** option collects spectra at intervals but not at the start or end of the ramp.



- Run the measurement: click **OK**, and ensure all experimental parameters in the other tabs of the **Spectral acquisition setup** window are correct. Click **OK**, and then click **Run** to start the measurement. This will effectively collect spectra of your sample at the

start and end temperatures and intervals in between, and hold the sample at the final temperature.

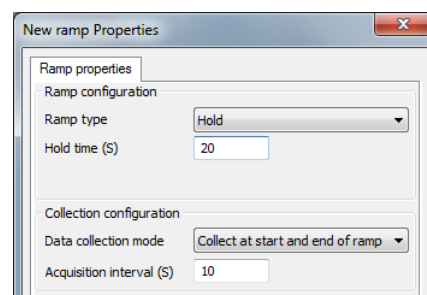
3. Several ramp and hold phases in a single measurement

Also including:

- Image capture
- Saving and loading of temperature parameters

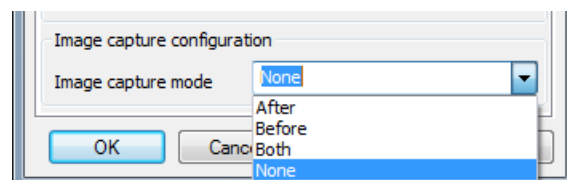
First, set up a ramp in the style of scenario 1 or 2. It is now possible to add further phases to this measurement.

- Add another ramp/hold phase: Click **Add...** in the **Spectral acquisition setup** window. (**Insert...** adds a ramp phase before the one selected, the other buttons are self-explanatory.) If another ramp phase is desired, configure as in scenario 1 or 2.
- Configure a hold phase: Select the **Hold** option under **Ramp type**. In a hold phase, the temperature of the sample is kept at the temperature at which the hold began, for a length of time defined in **Hold time (s)**. Spectra may be collected at the start and/or end of, and at intervals along, the hold in an analogous fashion to a ramp. However, the **Acquisition interval** is expressed in seconds, not °C.



- Image capture

The **Image capture mode** menu is used to select when images are captured relative to each spectral acquisition (before, after, both, or not at all.)



Click **OK**, and this next phase will be displayed in the **Spectral acquisition setup** window, and further hold and ramp phases can be added or inserted.

- Saving and loading of temperature parameters

In theory, there is no limit to the number of hold and ramp phases that can be run in a single measurement. Therefore, for particularly complex situations, it is useful to be able to save the temperature parameters. Click **Save** in the **Temperature** tab of the **Spectral acquisition setup** window. This will save the all of the temperature parameters defined in the **New ramp Properties** window for all of the ramps and holds present as a text file. However, this will not include any parameters defined outside of the **Temperature** tab.

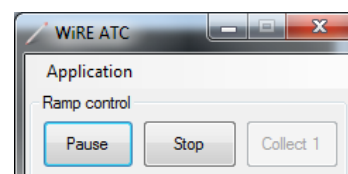
4. Run a pre-defined measurement with the capacity to view the sample in white light and interrupt and adapt as necessary.

If you have a general idea about the temperature information you want to collect, but there is a possibility that the sample will not behave as expected, WiRE offers useful features enabling you to react whilst the experiment is in progress. This uses an application called the Advanced Temperature Control (ATC).

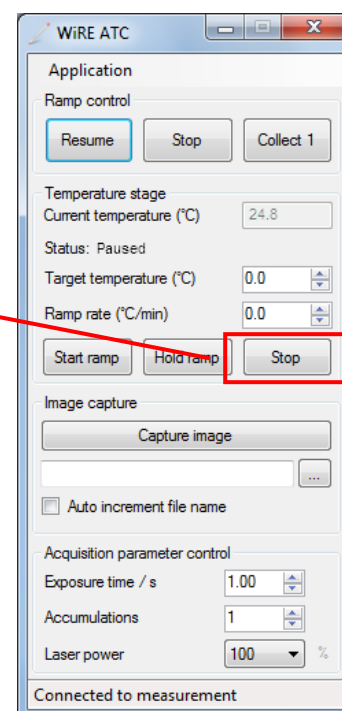
First, set up a measurement in the style of scenario 1, 2 or 3.

Before running the measurement, open the ATC application from **Start>Renishaw WiRE 5.0>Tools>Advanced Thermal Control**. This application allows the user to interact with the measurement once it has begun.

The **Live video** window should display the live white-light video image of the sample at all times except when a spectrum is being collected. Therefore, if the user wishes to change anything about the measurement, they can **Pause** it using the ATC, which holds the stage at the temperature at which it was paused, and enables a number of options:



- i. Collect spectra: Click **Collect 1** to collect a spectrum at the held temperature with the experimental parameters associated with the measurement. This spectrum is recorded in the same way as spectra collected at pre-defined intervals.
- ii. Run additional ramps: A ramp can be set up on a paused measurement using **Target temperature** and **Ramp rate**, and started and held with the appropriate buttons. The **Stop** button will allow the sample to cool to room temperature.
- iii. Capture white light images: First, select the location of where the image will be saved using the ... button. Then click **Capture image**. Capturing further images without selecting **Auto increment file name** or changing the save file will overwrite previous images.
- iv. Adjust experimental parameters: **Exposure time**, **Accumulations** and **Laser power** can be adjusted when a measurement is paused. This will be applied to all further spectral collections in the measurement, unless they are altered again.
- v. Resume the original measurement: Upon clicking on **Resume**, the stage will ramp to the temperature to which it was headed before the measurement was paused at the same rate. This will not necessarily start from the temperature at which the ramp was paused. (i.e. Changes made in the ATC tend to supersede those originally configured.)
- vi. Abort the measurement: Clicking the top **Stop** button will abort the whole measurement (abort dialogue will appear).



5. Run a measurement with no knowledge of the temperatures of interest or when to collect spectra.

This scenario will rely heavily on the advanced temperature control (ATC) application, so this should be opened from **Start>Renishaw WiRE 5.0>Tools>Advanced Thermal Control**.

In order for this application to be activated, a temperature series measurement must be initiated. Therefore, the simplest possible parameters will be set up. First open the **Temperature** tab in the **Spectral acquisition setup** dialogue, and tick the **Use temperature parameters** box. Then click **Add**.

Select **Hold** in the **Ramp type**, and set the **Hold time** to a nominal 20 s. Click **OK**, and **OK** again in the **Spectral acquisition setup** window, and **Run** the measurement. It is also necessary to configure a measurement, so select **Collect at start of ramp** under **Data collection mode**, and leave the **Acquisition interval** as 0 s.

Next, immediately click **Pause** in the **ATC** application, which unlocks the capabilities described in scenario 4. This enables *im promptu* ramps to be run and data and images collected and stored as desired.

To end the measurement, either click **Stop** in the **ATC**, which will abort immediately, or **Resume**, which will allow the original 20 s hold to run to completion.