



# UNIVERSITY of HOUSTON

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## Microwave Reactor Guidelines

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Microwave reactor *Biotage Initiator 2.0* is located in 48 Fleming. It is an instrument which allows rapid screening and optimization of reactions using microwave heating. Microwaves heat the solution directly—and not by convection through the vessel walls—leading to cleaner and faster reactions that can often be run without protecting atmosphere and in off-the-shelf solvents. Since the reactions are performed in sealed vessels, solvents can be heated to temperatures 50–70 °C above their boiling point—thus additionally speeding the product formation.

In principle, any reaction in any solvent could be attempted in the microwave reactor. However, since the setup involves a sealed system, never attempt reactions which produce stoichiometric amount of gaseous products—decarboxylations, diazonium salt manipulations, etc. Always attempt reaction at low concentration first and monitor their pressure before you attempt a scale-up. Finally, concentrated acids heat up too quickly in the microwave reactor; instrument recognizes this as a runaway reaction and automatically shuts down. Heterogeneous reactions are OK, as long as the solid is fully covered by the liquid and can be stirred without sticking to the vial walls.


### Using the Microwave Reactor

Before your first use, ask Gary Lim for a brief training session. If you are ever unsure about something, and especially if you are experiencing problems, ask Gary for assistance. These are the general directions only, and you should check with Gary if you are interested in customization:

1. Turn the instrument ON. Check that the compressed air supply is on, because the system will overheat if it is not.
2. Using the stylus (or your fingers, if they are sufficiently thin), tap on *Chemistry* on the touch-screen monitor.
3. Insert the crimped microwave vial with the sample into the cavity insert.

Microwave vials come in four sizes: 0.2–0.5 mL, 0.5–2.0 mL, 2.0–5.0 mL, and 10–20 mL. Make sure you do not overfill the vial, as this could cause an explosion. Vials can be

reused, as long as there are no visible scratches on them. Once you placed your solution on the vial, place an appropriate magnetic stir bar into it and then crimp the vial tightly. All the needed accessories (stir bars, vials, caps, crimper, decrimper) are in the drawer directly underneath the instrument in 48 Fleming.

4. Tap on the  icon to close the microwave cavity.

5. Tap on *Editor* to set the reaction parameters:

*Reaction time.* Every 10 °C increase in temperature speeds the reaction up 2–3 times.


*Temperature.* Operating range of the instrument is 40–250 °C. Most solvents can be safely heated up to 50–70 °C above their boiling point. There is little risk of an accident occurring if the temperature is set too high; the system will automatically shut down.

*Pre-stirring.* In case of heterogeneous mixtures, it is often helpful to pre-stir the reaction mixture before the heating is initiated.

*Vial type.* Select the size of vial you are using from the ones listed above.


*Absorption Level.* This setting adjusts the power of the instrument—lowers it for highly absorbing samples and increases it for poorly absorbing samples. Typically, organic solvents are "Normal", water is "High", and samples containing large amounts of salts, acids or bases are "Very High".

*Fixed Hold Time* and *Comment* are relatively unimportant.

6. Tap on  *Run* to start the reactor.

7. Tap on *Status* to view the current status of the instrument. You will be able to see the graph which will plot the dependence of (a) vial temperature, (b) pressure in the vial, and (c) instrument power on reaction time. Pressure is the most important variable: if your reaction develops more than 20 bar of pressure, the system will shut down. If the pressure develops too quickly, an explosion will occur. For an indication of the expected pressure of a reaction, use the solvent table or the vapor pressure calculator at [www.biotagepathfinder.com](http://www.biotagepathfinder.com). Temperature is also important: typically, your reaction should reach the temperature setpoint in ~30 s. If it does not, you chose a solvent that is not polar enough. Correct this situation by changing the solvent, or by adding a drop of a polar co-solvent (DMF, H<sub>2</sub>O).

8. Once the reaction is safely done, the reactor will automatically cool the reaction vial until its temperature drops below 40 °C. Tap on *Results* to view the experimental results.

9. Tap on the  icon to open the cavity. Take your vial out, decrimp it, and clean it (without scratching it) if you plan to reuse it.

### Monthly Maintenance

A monthly inspection of the microwave reactor will be performed by Gary Lim every last Saturday of the month. Do not plan to run any microwave-assisted reactions on these days.

For more information, consult (a) Ognjen, (b) books on microwave synthesis in Ognjen's office, (c) review articles on MAOS (microwave-assisted organic synthesis), and (d) Biotage website.