

# MICROWAVE *Synthesis*

MANUAL REACTORS

AUTOMATED WORKSTATIONS

FLOW SYSTEMS

SCALE UP SYSTEMS

PARALLEL SYNTHESIS

TEACHING SOLUTIONS



**CEM**

# Do I really need to use microwave technology?

If you work with any type of chemical synthesis or chemical reaction, **THE ANSWER IS YES!**

Microwave synthesis is a well-accepted technique used by research facilities and major pharmaceutical, biotech, and chemical companies worldwide. This new technology is changing the way many reactions are performed, as well as pre-conceived ideas about the capabilities of microwave synthesis.

Microwaves are a low-frequency energy source that are remarkably adaptable to many different types of chemistries from high-temperature nanomaterial synthesis reactions to low temperature carbohydrate reactions.

- OPEN NEW REACTION PATHWAYS
- INCREASE YIELDS IN DIFFICULT REACTIONS
- INCREASE PURITY PROFILES/SELECTIVITY IN PRODUCT MIXTURES
- DECREASE REACTION TIMES FROM HOURS OR DAYS TO MINUTES

Microwave energy passes through the vessel walls and interacts directly with the reaction components, heating the reactants rapidly and more evenly than conventional methods. It is also an "instant on/instant off" energy source, significantly reducing the risk of overheating reactions. Conventional or bulk heating methods, such as oil baths and heating mantels, must first heat the vessel before the energy can be transferred to the reactants. This results in slower heating that continues to progress for a time after the energy source has been removed or turned off.

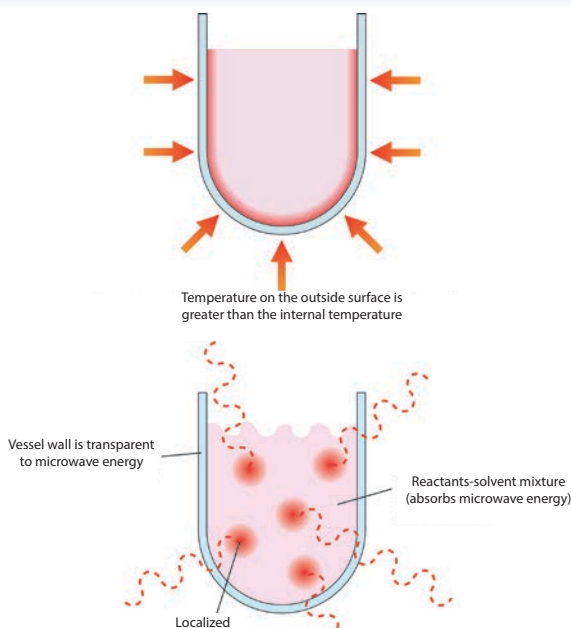


## Convective Heating

Energy is transferred indirectly to the reactants by applying heat to the outside surface of the vessel. This form of heating is very slow and inefficient.

## Microwave Heating

Since the vessel wall is virtually transparent to microwaves, energy is directly absorbed by the reaction, providing instantaneous activation or localized superheating of the molecules in solution. This direct molecular activation limits side reactions and provides a fast and efficient form of heating.



DRUG DISCOVERY   MEDICINAL CHEMISTRY   TRADITIONAL ORGANIC CHEMISTRY  
POLYMER CHEMISTRY   MATERIALS DEVELOPMENT   NANOTECHNOLOGY

For a more detailed discussion of the fundamentals of microwave heating, please visit [www.cem.com](http://www.cem.com).

# DISCOVER THE DIFFERENCE

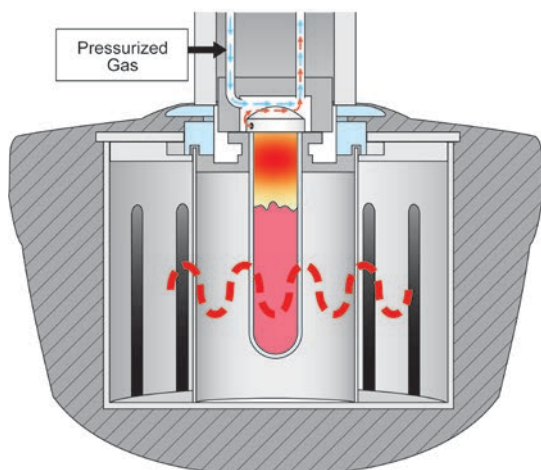
The Discover® System is the most flexible platform for microwave synthesis available. Built around a large single-mode cavity, Discover's advanced design and proven capabilities give the user uncompromising performance in a compact system. Perform reactions at reflux, under a nitrogen environment, or in a pressurized vial, all in the same system.



Discover's unique modular design gives you the unparalleled ability to add accessories or upgrade your system as needed with ease.

## Activent Technology

Control your reaction in more ways than ever before! Designed exclusively for the Discover SP, Activent™ provides a level of pressure control unattainable in any other microwave synthesis system and gives you the ability to choose how you vent excess gas – during a reaction or afterward. CEM's patented Activent Technology is the latest advance in automated pressure control and the safest way to perform pressurized reactions. Users can also program the Discover SP to vent these high temperature/high pressure vials at a user-designated pressure.



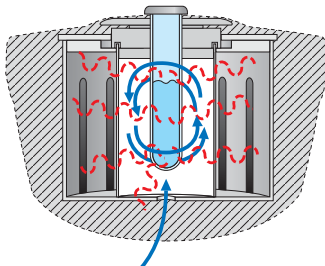


# DISCOVER FLEXIBILITY

Discover is truly a revolution in technology with a number of patented features that make it the most versatile and dependable microwave synthesis system available. Our chemists and engineers work very closely throughout the design and development process to ensure that our systems are dependable, easy-to-use, and have the features that are not only useful, but also inspire creativity.

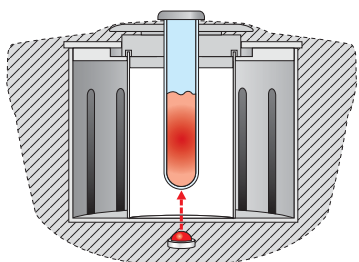
## PowerMAX Simultaneous Cooling

One of the reasons microwave energy works so well for driving synthetic reactions is because it heats kinetically, not thermally. Localized superheating raises the temperature of the reactant mixture, but energy is actually transferred kinetically. CEM's patented PowerMAX™ technology uses compressed gas to cool the reactant mixture while simultaneously applying more energy than would normally be used. Chemistries proceed much more quickly than normal and do not have time to form side reactions. This technology is ideal for reactions that require a substantial amount of energy, but may be temperature-sensitive.



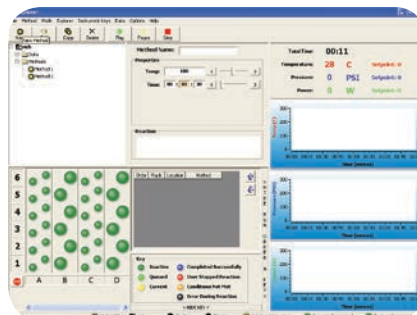
## Volume-Independent Temperature Sensor

Discover is the only single-mode microwave synthesis system with an infrared temperature sensor in the floor of the cavity. The position of the sensor enables Discover to accurately measure temperature in volumes from 0.2- to 50-mL without the need for specialized vessels. Perform reactions up to 300 °C, the highest temperature possible in a single-mode microwave system, using the infrared temperature sensor.



## Automatic Vial Size Recognition

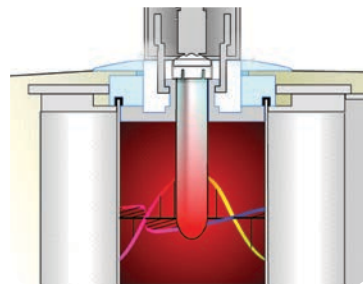
The Explorer SP automated sample decks are designed for automatic vial recognition to allow seamless transitioning from 10-mL to 35-mL pressurized vials. No additional programming is necessary.



## IntelliVent Technology

### Pressure Management & Control for Discover LabMate

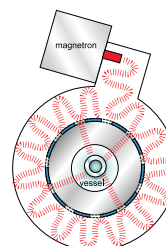
IntelliVent™ continuously monitors the pressure in the vial and is designed to ensure safe operation at all times. When coupled with our snap-on caps, this technology relieves excess pressure in the reaction vessel, for your safety before, during, and after a reaction. No manual venting with needles is required.



Sealed Vial Reaction at Pressure > 20  
Bar w/Automatic Venting  
IntelliVent Technology

## Self-Tuning Single-Mode Cavity

No need to guess about the correct position of the vial. With Discover's patented self-tuning microwave cavity, your vial is positioned correctly every time for the optimum amount of energy to reach the reaction and give you reproducible reaction conditions and results. Should your sample change during the course of the reaction, the microwave will change with it. The self-tuning cavity will ensure your sample, no matter how large or small, polar or nonpolar, will receive uniform microwave power during the reaction.



# DISCOVER MICROWAVE SYNTHESIS

Only Discover offers a modular platform that is customizable to fit your needs. Start with one of the four basic systems and select any additional capabilities you need.

All Discover Systems include the following features.

- Perform reactions at temperatures up to 300 °C
- Patented infrared temperature feedback and control
- Integrated stirring
- Patented PowerMAX Technology



## Discover LabMate

All of the above features, plus our patented IntelliVent pressure feedback and control, as well as Synergy™, a specially designed software package for the Discover platform that allows methods to be programmed, stored, and performed using a PC. Synergy also enables you to easily convert conventional reactions to microwave methods and draw schemes. Data from each run can also be stored using this software package.



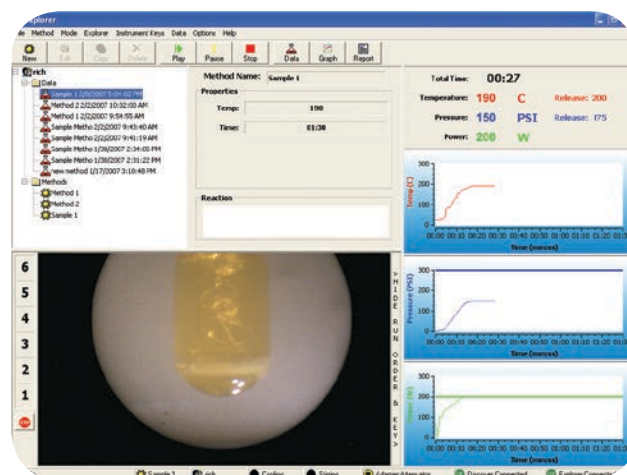
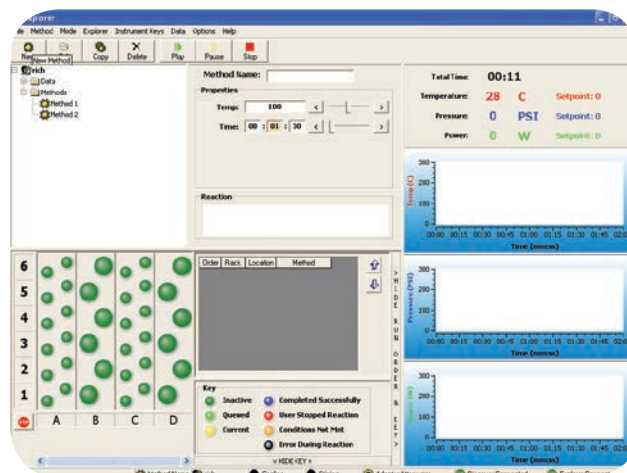
## Discover SP

The latest in single-mode technology, the Discover SP takes microwave synthesis to the next level with features such as automated pressure management, the ability to perform reactions in either 10-mL or 35-mL reaction vessels with the patented Activent Technology, and the Synergy software package. You can even watch your reaction as they take place with the optional camera! The Discover SP can also be easily upgraded with an automated Explorer-12, -48, -72, or -96 position sample deck.

# SYNERGY SOFTWARE

Discover LabMate and Discover SP both include CEM's Synergy software package. With its intuitive interface, Synergy is simple to use and greatly expands the capabilities of your Discover or Explorer System.

- Operate your Discover-based Microwave Synthesis System from a PC
- Create and store methods
- Draw reaction schemes
- Convert conventional chemistries to microwave reactions
- Check on the progress of your reaction from your desk with the remote viewing feature
- View reactions with the camera option (available for Discover SP only)



# FLASKS & VIALS

## Sealed Reaction Vials

Both our patented Activent and IntelliVent Technologies are designed to ensure safe operation at all times. Both combine our specially designed vial caps with a performance engineered pressure transducer. This proprietary technology relieves excess pressure in the reaction vessel for your safety before, during, and after a reaction. No manual venting with needles is required.

## 10-mL and 35-mL Vials

CEM offers both 10- and 35-mL vials that incorporate a specially designed cap which simplifies sealing and eliminates crimping devices. Simply place the cap onto the reaction vessel and seal it into place. Upon reaction completion, the pressure devices ensure safe handling, so just pop the top and work up the reaction as normal.

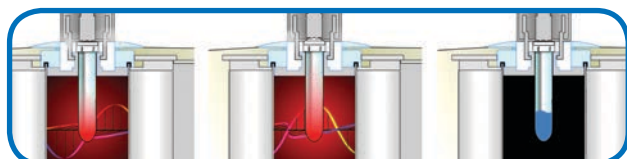
### 10-mL vials

Volumes from 0.2 to 7 mL can be run in a single vial, eliminating the need to inventory multiple vials. The 10-mL vials can be used with any Discover or Explorer System.

### 35-mL vials

This vial is exclusive to the Discover SP and can accommodate a range of 2.5 to 25 mL. It is the largest vessel that can be automated for microwave synthesis.

**No one offers more versatility in vial and vessel options for synthesis than CEM**



Sealed Vial Reaction  
at Pressure > 20 Bar

Sealed Vial Reaction  
at Pressure > 20 Bar  
w/ Automatic Venting

Sealed Vial Reaction  
Complete and Pressure  
Automatically Normalized  
Before Vial Release

# OPTIONAL REACTION VESSELS

## Standard Glassware

All Discover Series systems can be run at atmospheric conditions using off-the-shelf glassware. The Discover System will accommodate up to a 125-mL round-bottom flask. Perform your reflux reactions with the speed of microwave synthesis.



## 80-mL Vessel

After the reaction has been optimized on a small scale, larger scale reactions are always of interest. Use of the 80-mL reaction vessel ensures direct scalability from the 10-mL vessel all the way to the 80-mL vessel. It can be used with any Discover Series system.

## Flow Cells

Add your own pumps and move material through the Discover cavity using specially designed flow cells from CEM. Solid-supported catalysts can be loaded into the cell or the cell can be used as is. Couple the benefits of microwave technology with flow chemistry and take advantage of both technologies.



# EXPLORER AUTOMATION

Optimize your reactions and expand the capabilities of your laboratory without expanding your laboratory space. Explorer modules for the Discover platform provide fully automated reaction handling capabilities and are an ideal solution to support small groups of chemists as a shared resource.



## EXPLORER 12 HYBRID

All the benefits of a large format autosampler within the footprint of the world's smallest manual reactor. This twelve position autosampler accommodates both the 10- and 35-mL vessels and is the best value of any autosampler commercially available.



## EXPLORER 24

Easily upgradable, this 24-position system is an affordable automated synthesis solution for academic and small research groups. Utilizes 10-mL reaction vessels.



## EXPLORER 48, 72, & 96

CEM manufactures autosamplers to accommodate up to 48, 72 or 96 ten-mL vials or a combination of 10-mL and 35-mL vials. Intelligent rack design allows the autosampler to recognize the vial type without user input and the integrated robotics ensure that switching between 10-mL and 35-mL reaction vials occurs seamlessly, freeing your time for other things.

# ACCESSORIES

## Fiber Optic Temperature Control

Fiber Optic Temperature Control provides the most precise temperature measurement available, by directly measuring the temperature inside the reaction vial. It can be used with 10-mL reaction vessels designed for this purpose, as well as with the 80-mL vessel. Other accessories, including the CoolMate™ and Gas Addition kit use this type of temperature measurement.



## COOLMATE

The CoolMate is the only commercially available microwave system designed to perform reactions at sub-ambient temperatures. Reactions such as lithiations, carbohydrate synthesis, and other temperature-sensitive materials can now benefit from the use of microwave energy. Use the power of microwave energy to accelerate reactions even at temperatures as low as -80 °C.



## GAS ADDITION

The Gas Addition accessory is the only system specially designed for reactions with gaseous reagents. Perform hydrogenations, carbonylations, or other reactions with gaseous reagents or simply use the vessel to ensure an inert atmosphere during microwave irradiation. This system allows you to purge the reaction vessel and back-fill it with a gas. During the reaction, the gas source is completely shut off from the microwave, thereby ensuring your safety at all times.



## CAMERA

The optional integrated Camera allows you to see the changes occurring in your reaction in situ; a perfect tool for documentation and publication support.



# SCALE UP SOLUTIONS

## MARS 6 System for Scale Up

Scale up your reactions with microwave speed using the MARS 6 Microwave Reaction System. CEM offers a full range of vessels and flow cells up to 5 L, or you can use your own reflux condensers and standard glassware.

## MARS 6 System for Parallel Synthesis

Multiple vessel sizes provide the most flexibility and high throughput for large volumes or multiple reactions. Perform reactions at high temperatures (up to 300 °C) or high pressures (up to 1500 psi) in parallel. Use glass, Teflon®, or even Quartz vessels to ensure chemical compatibility. Vessels use fiber optic temperature measurement and pressure feedback to safely control reactions.



# DISCOVER

## FEATURES, OPTIONS, & ACCESSORIES

FEATURES	Discover LabMate	Discover SP
Atmospheric Pressure	✓	✓
Infrared Temperature Feedback & Control	✓	✓
Integrated Stirring	✓	✓
PowerMax	✓	✓
Pressurized System	✓	✓
Pressure Management & Venting	✓	✓
IntelliVent	✓	
Activent		✓
Synergy Included	✓	✓
Optional Mobile Interface	✓	✓
Optional 80-mL Vessel	✓	✓
Optional Camera	✓	✓
Capability To Run 35-mL Pressure Vessels		✓
<b>ACCESSORIES</b>		
CoolMate-Sub-Ambient Microwave Synthesis (run reactions at temperatures as low as -80 °C)	✓	✓
Gas Addition Kit	✓	✓
Hydrogenation	✓	✓
Flow System	✓	✓
Peptide Synthesis	✓	✓
<b>AUTOMATION UPGRADE</b>		
Explorer - 24 Sample Deck	✓	
Explorer -12, -48, -72, -96 Sample Decks		✓

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