

MICROWAVE SYSTEMS FOR INORGANIC MATERIALS CHEMISTRY



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 proven technology that has been used by research facilities and major biotech, chemical, and pharmaceutical corporations worldwide for many years. Microwaves are remarkably adaptable to many different types of transformations, from high-temperature quantum dot synthesis to low-temperature carbohydrate chemistries. Microwave energy has been shown to:

- Open new reaction pathways
- Increase yields in difficult chemistries
- Increase purity profiles/selectivity in product mixtures
- Decrease reaction times from hours or days to minutes
- Rapidly raise the reaction mixture to the desired temperature
- Evenly heat sample (no more wall effects)
- Promote uniform particle growth

Microwave 101

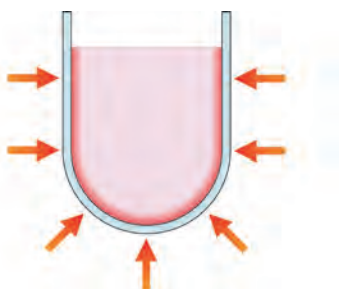
Unlike conventional convective heating, microwave energy will directly interact with any material that is ionic or has a dipole. As a result, samples are heated more quickly and effectively than conventional convective methods.

A low-frequency energy source that does not create or break bonds, microwaves pass through vessel walls and interact directly with the reaction components, heating the reactants rapidly and more evenly than conventional methods. Microwaves are 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, resulting in slower heating that continues to progress for a time after the energy source has been removed or turned off.

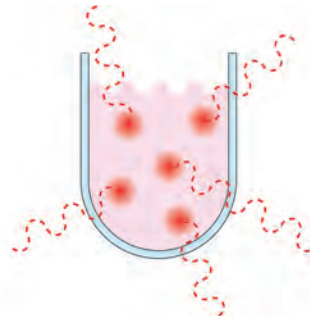
The ionic nature of inorganic compounds gives them the unique ability to rapidly absorb microwave energy and heat to very high temperatures much faster than molecules that only incorporate a dipole for microwave power absorption. Direct activation of the reactants ensures that the materials that need energy, receive energy, resulting in rapid transformations and better yields.

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



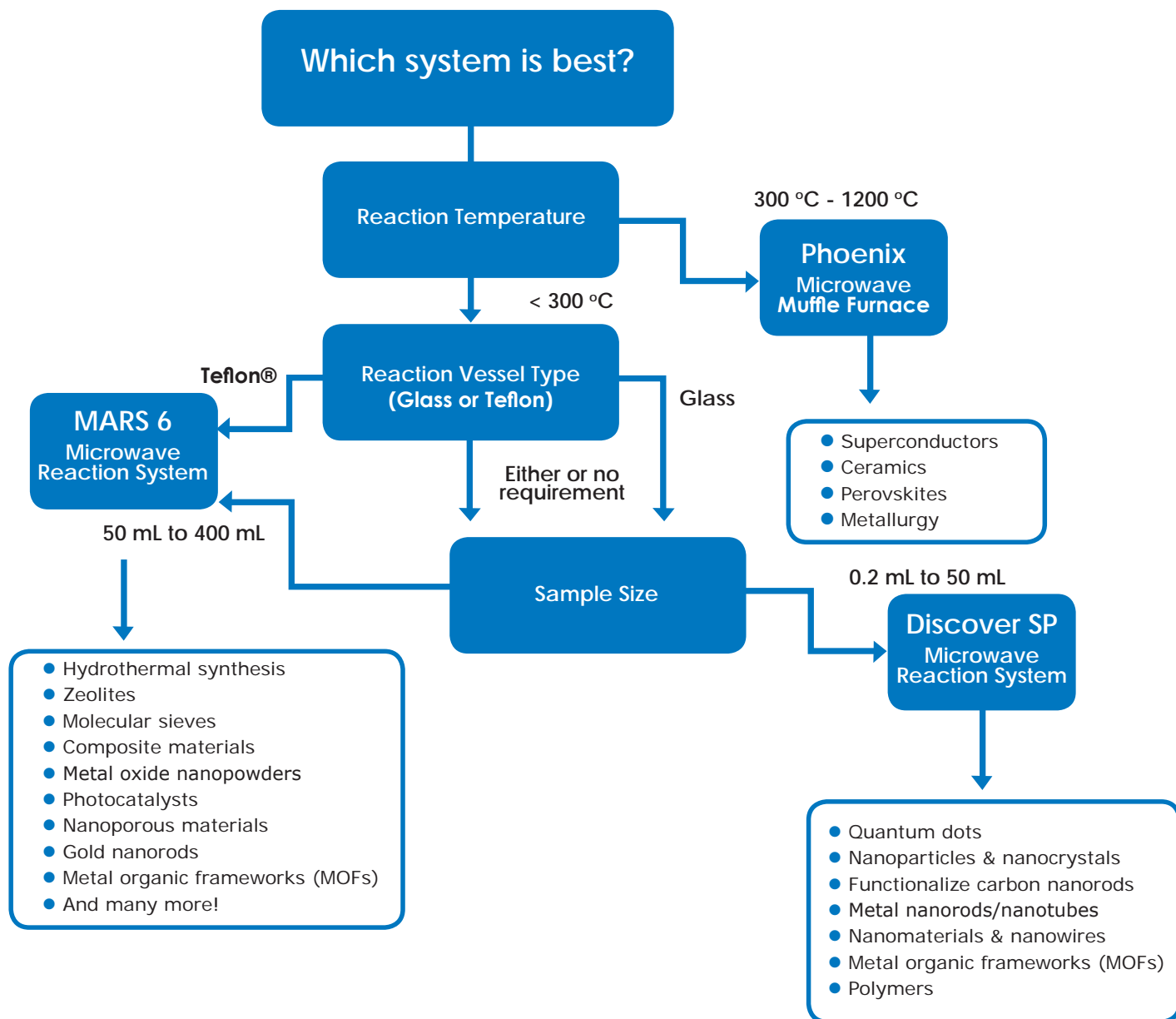
Since the vessel wall is virtually transparent to microwaves, energy is directly absorbed by the reaction, providing instantaneous activation or localized superheating of the molecules in solution. This direct molecular activation limits side reactions and provides a fast and efficient form of heating.

Choosing the Right System for You

CEM systems are unique in their ability to be extremely flexible, ensuring complete customization of a system to meet your needs. Beyond standard high temperature/high pressure conditions, CEM gives you additional flexibility to perform reactions:

- under an inert environment;
- in a vacuum; and,
- watch as it takes place with our camera option!

The possibilities are endless. Microwave energy gives you rapid heating, high temperatures and unmatched control.



Discover SP

Advanced Microwave Technology for Greater Flexibility

Features

300 WATTS OF FOCUSED ENERGY

Efficient power delivery for maximum reaction control

SELF-TUNING WAVEGUIDE

Adjusts for changing chemical properties to optimally energize sample

ACTIVENT™ PRESSURE RELIEF

Programmable reaction venting to release gaseous byproduct and reduce vessel failures

VOLUME-INDEPENDENT TEMPERATURE MEASUREMENT

Reduces the number of vessels needed to accommodate a large working volume

POWERMAX™ SIMULTANEOUS COOLING

Allows maximum energy input to the reaction while simultaneously cooling it, improving yields and decreasing side reactions

300 mL MICROWAVE CAVITY

Large cavity provides unprecedented access and vessel flexibility

WORKING VOLUME

- 0.2 – 50-mL pressurized
- 0.2 – 75-mL reflux

VESSEL CHOICES

Pressurized - 10-, 35-, or 80-mL vessels
Atmospheric - Use standard laboratory glassware

POST-REACTION COOLING

Rapidly quench reactions upon completion

SOFTWARE & KEYPAD CONTROL

Intuitive Synergy™ software and backup control

AUTOMATION

Allows unattended operation and prevents down-time between reactions

ACCESSORIES

Provides the utmost flexibility in chemistry exploration

- 80-mL pressurized glass vessel
- Camera - View reactions in situ
- 10-mL flow cell
- Gas addition for inert atmosphere
- Automation decks
- Fiber optic temperature monitoring



MARS 6

Perform a single, large scale reaction or multiple reactions in parallel

Features

1800 WATTS DELIVERED ENERGY

Highest available power for rapid heating of reactions regardless of the number of vessels in the cavity

LARGEST MICROWAVE CAVITY

Allows for the greatest range of reaction vessels

- Up to 36 pressurized vessels
- Up to a 5-L open flask

RUGGED, HIGH-GRADE 316 SOLID-STEEL CAVITY

Multi-layer Teflon® coating provides maximum protection against corrosion

HEAVY-DUTY, SPRING-MOUNTED, PRESSURE RELIEVING DOOR WITH SAFETY INTERLOCKS

SOLVENT- AND IMPACT-RESISTANT COMPOSITE SHELL

Superior system protection from a laboratory environment than painted metal wraps

SPECIALLY DESIGNED CAVITY & WAVEGUIDES

Ensures uniform distribution of microwave energy uniformity without need of a mode stirrer

HIGH-RESOLUTION, FULL COLOR TOUCHSCREEN WITH SPEAKERS

No need for a laptop or external controller

INTUITIVE SOFTWARE CONTROL

Quickly program new methods, load existing methods, and recall run data

FIBEROPTIC TEMPERATURE CONTROL

SAFETY CONTROLS

Sensor and feedback monitoring to prevent vessel events for maximum operator safety

8-GIGABYTE MEMORY

Touchscreen interface provides easy access to stored methods, real-time data, and results of past runs

CONNECTIVITY

Available ports: 5 USB, 1 USB-B, 2 Ethernet, and 1 RS-232

ONBOARD TRAINING VIDEOS

Learn how to properly assemble vessels and operate a MARS 6



PERFORM OPEN OR CLOSED VESSEL REACTIONS

- Use standard laboratory glassware
- Purge reactions prior to irradiation
- Set up a low-pressure environment during your reaction
- Highest temperature capabilities for high pressure vessels
- Wide variety of durable, easy-to-use vessels to choose from including Teflon®, glass, & quartz

Phoenix

Microwave Muffle Furnace for High-Temperature Synthesis up to 1200 °C

Features

RAPID HEATING

Up to 10X faster than conventional muffle furnaces

PROGRAMMABLE TEMPERATURE CONTROL

CLEAN, COOL OPERATION

ENTER & STORE UP TO 20 METHODS

AUTO-START/AUTO-SHUTDOWN SOFTWARE

USE A VARIETY OF CRUCIBLES

Any crucible that can be used in a conventional muffle furnace can be used in the Phoenix, including platinum

2 FURNACE CONFIGURATIONS AVAILABLE

BUILT-IN EXHAUST SYSTEM

BUILT-IN CALIBRATION & DIAGNOSTICS SOFTWARE

NIST-TRACEABLE ACCESSORIES

OPTIONAL APPLICATION OF INERT ATMOSPHERE

Phoenix



Crucibles



Highlighted References

Below are just a few reference examples of the benefits of using a CEM microwave system for your research. Visit our website for a more comprehensive listing of reference papers, articles, and application notes.

Discover SP

Inorganic Nanomaterials

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Why choose CEM?



We can help

As the leading provider of microwave laboratory systems in the world, we have more than 35 years of experience designing and manufacturing products of superior quality, performance, and reliability. Our applications chemists and service engineers are well known for their expert and timely assistance, ensuring that laboratories using CEM instruments are always running the chemistry needed to get results, fast.

Your partner in research

CEM is a company driven by scientists and their vision. We understand the challenges facing today's academic community and we are committed to supporting educational initiatives aimed at helping students and professors achieve outstanding results in their laboratory.

Resources at your fingertips

No matter what kind of inorganic synthesis you want to perform: perovskites, nanomaterials, quantum dots, polymer, MOFs, zeolites, photocatalysts, composite materials, or any of a number of other reactions, we have the microwave systems and the resources you need to get started today.

Have questions?

Contact us!

We can help you determine which system would be right for your research.

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