StonyLab®

Microwave Chemical Reactor

Operation Manual

(Please read the instruction carefully before you use the machine)

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I. Introduction

Natural microwaves are dispersed and not concentrated enough to be used as a source of energy. However, by using a magnetron, electrical energy can be converted into microwaves that oscillate at a frequency of 2,450 MHz per second and penetrate through a medium. The medium's dielectric constant and dielectric loss determine whether it undergoes high-frequency oscillation in an alternating electromagnetic field, resulting in the accumulation of energy within the medium. Both thermal and non-thermal effects can be produced simultaneously for chemical reactions.

Non-polar materials such as polytetrafluoroethylene do not absorb microwave energy, while metals reflect it. The output power levels of household microwave ovens are fixed, and lower power levels are achieved by adjusting the on-off time (duty cycle) of the current. By using a microcomputer to control the on-off time of the current, strict timing can be achieved, allowing for the selection of identical working conditions to achieve repeatable chemical reaction conditions.

II. Application

Microwave chemical reactor is a specialized instrument used for conducting chemical reactions using microwave radiation as a source of energy. In a microwave chemical reactor, microwave radiation is used to generate heat, which causes the molecules of the reactants to vibrate and collide, leading to rapid and efficient heating of the reaction mixture. The use of microwave radiation can significantly reduce the reaction time, increase yield, and improve the selectivity of the reaction.

Microwave chemical reactors are used in a wide range of applications, including organic synthesis, polymerization, materials science, and biochemistry, which is a valuable tool for researchers and industrial scientists alike.

III. Schematic Diagrams

1. Model 205

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3. On
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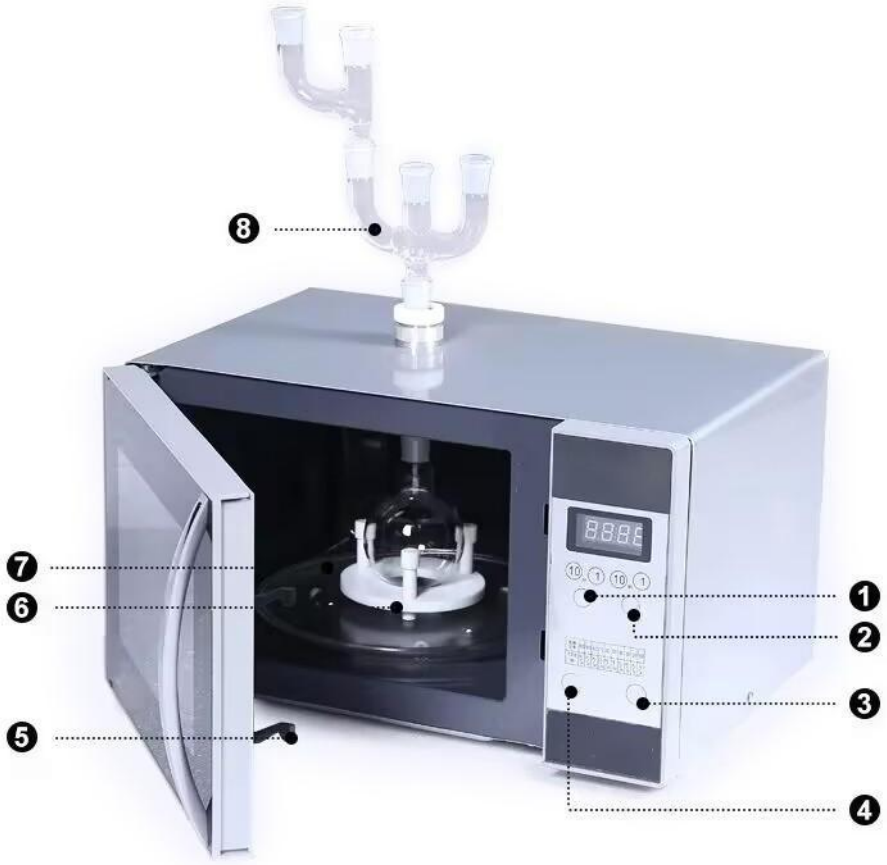
6. Stirring Adjustment Knob
7. Switch
8. Wattmeter
9. PTFE Plate Frame
10. Door Interlock Switch
11. H-type Glass Tube

2. Model 201



1. Microwave
2. Power Option
3. Off
4. On
5. Door Interlock Switch
6. PTFE Plate Frame
7. Glass Tablewheels
8. H-type Glass Tube

IV. Specification

Model	Model 201	Model 205
Uniform Heating Method	Rotation Turntable	Magnetic Stirring
Frequency Performance	10-level adjustment	arbitrary adjustment
Power Consumption (W)	1100	1300
Max Output Power (W)	600-650	750-800
Input Current (A)	7.8	7.8
Voltage (V)	220	220
Microwave Frequency (Mhz)	2450±50	2450±50
Chamber Dimensions (mm)	290x290x190	300x330x200
Overall Dimensions (mm)	480x400x320	490x400x440
Weight (Kg)	20	35

V. Features

1. The maximum power output of the device is 800W.
2. Adjusting the device to one of its 5 power levels and varying the on-off time, desired results can be achieved.
3. Varying the power level and duration of operation can result in consistent reaction conditions with satisfactory repeatability.
4. The device can be used with a reflux device while ensuring no microwave leakage from the cutoff waveguide.
5. The PTFE plate frame is adjustable in height for added convenience.
6. The device is designed to be used with glass accessories commonly found in chemical reactors.

VI. Use Instruction

1. Cutoff Waveguide

The cutoff waveguide is positioned at the top of the furnace chamber. In case it becomes loose during transport, please ensure that it is tightened.

2. PTFE Plate Frame

The PTFE plate frame can be adjusted using 3 long screws, screwing them into the screw holes. The height can be adjusted as required. Do not touch the shaft at the bottom of the chamber after placing the object, and make sure the flat head of the screw is facing up. Any spare short screws are reserved for other special configurations.

3. Device Placement

(1) Working Environment: It is recommended to place the device in a fume hood, and it should be kept horizontal. The top reflux device or liquid adding device should be secured to an experimental iron frame. No objects should be placed within 15 cm of the rear ventilation opening. It is not allowed to remove the furnace feet for placement.

(2) Power Supply: The ideal power supply is a regulated power supply. If not available, use a dedicated power supply line that is not shared with other large equipment. The circuit must be properly grounded and use fuses with a rating of 8A or higher.

VII. Operation

1. Sealing Experiment

When conducting the tube sealing experiment, it is essential to take

note of the following points to ensure the safety of both the user and the microwave oven:

(1) It is not advisable to carry out tube sealing experiments with gas-producing reactions.

(2) The tube used should be made of high borosilicate glass that is pressure-resistant, and the amount of reaction material should be strictly regulated.

2. Liquid or Liquid-solid Reactions

For small reaction volumes that do not require stirring, a flask with a volume of 50 ml or 100 ml can be used. The PTFE plate frame should be positioned in the center of the furnace bottom, and the straight tube should be inserted into the flask through the cutoff waveguide from the furnace. Furthermore, an appropriate reflux device should be above the furnace top.

If the reaction volume is significant, a flask with a volume of 50 - 250 ml can be used. The straight tube should pass through the cutoff waveguide from the furnace top to examine the flask joint and must be equipped with a U-shaped or Ψ-shaped 3-way connection tube, a stirrer, a reflux device, and a dropping funnel.

Note:

- Model 201 device is equipped with a glass turntable and a turntable bracket, which must be removed before use.
- Model 205 device features a bottom-mounted magnetic stirrer that allows for clockwise rotation at variable speeds, ranging from low to high. if stirring rod is necessary, please note that only glass or PTFE stirrers should be used, not metal ones.

3. Solid-phase Reactions

When conducting the solid-phrase chemical reactions,flexible arrangements of reactors and work modes are possible according to reaction requirements, but the following principles must be followed:

(1) Reactions that produce gases, particularly corrosive or irritating ones,

may harm circuits and computer boards. It is essential to install reflux devices and draw the gas out of the furnace through a conduit.

(2) The dielectric constant and medium loss of the reactants and products differ, causing varying absorption of microwaves in the microwave field. As a result, local temperature differences frequently occur during solid-phase reactions, necessitating stirring, shaking, and the selection of lower power levels to ensure the reaction proceeds as uniformly as possible.

(3) Under no circumstances can chemical reactions be conducted in an open or sealed container within a microwave reactor. The former can cause splashing and cavity contamination, while the latter is at risk of explosion.

VIII. Attention

1. Ensure the reactor furnace structure remains sealed. The waveguide dimensions have been precisely calculated and verified with a microwave leak tester to comply with state regulations. Do not tamper with the waveguide.
2. Do not use an airtight container without proper safety features.
3. Avoid operating in the cavity.
4. Use the lowest possible power setting.
5. When dealing with unknown chemical reactions, initiate tests with lower power settings.
6. Refrain from placing any metal objects inside the furnace.
7. Utilize a 14-interface PFA hose to protect the trachea. Only use PFA material as it is microwave transparent; avoid substituting it with other materials.
8. After use, turn the power adjusting knob counter-clockwise to the off position.
9. Do not heat low boiling point reagents or flammable materials in the cavity of the reflow device.