## Calibration

This term refers to the identification and mapping of hot and cold spots inside the microwave cavity. After mapping, a region or number of discrete locations have been identified and labeled as sites for sample placement in the microwave cavity during processing.

## Dipole Rotation

Dipole rotation is the alignment or orientation of polar molecules in response to the microwave's electric field. Molecular motion due to this alignment is thought to cause microwave heating.

## Dissipation Factor-Microwave Heating

Dissipation factor is a measure of the samples' dielectric properties and the penetration depth of the microwave into the sample. It is a numerical value describing the ability of a sample to absorb microwave energy and dissipate that energy in the form of heat (i.e. energy lost to the sample = microwave heating) (see Kok LP, Boon ME (1992) Microwave Cookbook for Microscopists, 3rd ed. Leyden, Coulomb Press, pages 42-43). The penetration depth is great (usually measured in metres) in transparent materials, negligible (measured in nanometres) in reflective materials and finite (measured in millimetres or centimetres) in absorptive samples/materials.

## Hot Spots - Cold Spots

The standing wave patterns generated by the closed cavity design of microwave ovens result in regions referred to as hot and cold spots. These regions cause uneven heating of samples during microwave exposure.

## Impedance Matching

The condition inside the microwave cavity where the sample absorbs all the microwave energy and there is no reflected energy.

## Indirect Determination of Microwave Power Output

This is a simple method to determine the power generated by the magnetron as measured in Watts. Indirect power output determination to the microwave cavity is determined by the following method

1. Fill a glass or plastic 1-litre beaker with exactly 1000ml of 20°C±2°C tap water.
2. Pre-warm the microwave electronics by running the microwave at 100% power for at least two minutes (always place a water load of at least 200ml in the microwave cavity during pre-warming).
3. Place the water-filled 1-litre beaker in the center of the microwave cavity and record the water temperature to the nearest 0.1°C prior to irradiating for 2 minutes at the maximum or 100% power setting.
4. At the end of the 2 minutes stir the water in the beaker and record the temperature to the nearest 0.1°C.
5. Multiply the temperature difference by the number 35. The product is the magnetron power output measured in Watts. The accuracy and validity of using this methodology for a microwave power determination is dependent on using the same type of beaker and cavity location each time the test is performed.

## Ionic Migration

Ionic migration is the movement of dissolved ions due to the presence of the microwave's electric field. Resistance in the solution to migration is thought to result in microwave heating. The addition of 0.1M NaCl to water at a temperature of 25°C will decrease the penetration depth to 1.5cm from 2.3 cm of water and increase the dissipation factor of the solution from 1570 (water) to 2400 (water + 0.1M NaCl).

## Magnetron

Diode with an anode and cathode plus a magnetic field aligned with the cathode. When a potential of several thousand volts is reached across the diode, the magnetron oscillates and electrons are released which resonate under the influence of the magnetic field. Microwaves are radiated by an output antenna into the waveguide. Magnetrons used for household or laboratory microwave ovens are fixed-tuned and release energy at a frequency of 2.45 GHz (2450 MHz), ±50 MHz.

## Magnetron Duty/Cycle Time

The duty or cycle time of the magnetron is the time the magnetron is on divided by the time base. Percentage power is another term for this type of power delivery. A typical time base for a laboratory microwave is 1 second and for a household grade microwave 10 seconds or longer. A 50% duty cycle for a microwave with a 1 second time base is 0.5 seconds on and 0.5 seconds off and for a microwave with a 10 second time base it is 5.0 seconds on and 5.0 seconds off.

## Microwave Cavity

This is the site for sample processing. Microwaves entering the cavity are continuously reflected from wall-to-wall. The pathways of the microwaves are well defined and result in what are called standing wave patterns.

## Mismatching

Mismatching is a condition inside the microwave cavity when the sample does not absorb all the microwave energy. This produces reflected energy (i.e. mismatching) which can cause magnetron overheating, a reduction in power output with the eventual destruction of the magnetron if the condition is allowed to persist.

## Mode Stirrer

Also referred to as the wave or field stirrer, is designed to reflect and mix the microwave energy entering the cavity from the waveguide. The stirrer moderates positional heating differences associated with sample placement in the cavity.

## Percentage/Intermittent/Partial or Discontinuous Power

The time the magnetron is on relative to the duty cycle of the microwave oven. An 800W microwave set at 100% power would deliver 800W of continuous power for the time period selected. The same microwave set at 50% power would deliver 800W for one-half the time period selected.

## Standing Wave Patterns

The patterns result from the closed cavity design of microwave ovens. Standing wave (electric field) patterns are characterized by regions of high to low electric field density. The shape and size of these regions is dependent on the microwave cavity dimensions.

## Temperature Control

Temperature control implies the use of a measuring device within the microwave cavity that will monitor and control the temperature of the sample being processed. Temperature control is established by intermittent or discontinuous power output by the magnetron. The shorter the magnetron duty/cycle time the more precise the temperature control. Long duty cycles will result in less precise temperature control.

## Time at Temperature Protocols

Time at temperature protocols indicate the total time of microwave irradiation after attainment of a preset temperature maximum. The time does not reflect the microwave irradiation time required to reach the temperature maximum.

## Total Time Protocols

Total time protocols indicate the total time of microwave irradiation for any given microwave-assisted step.

## Variable Wattage

One of a number of terms (linear power control) referring to continuous power output of the magnetron at different wattage outputs or levels.

## Waveguide

Microwaves radiated by the output antenna are channeled into the waveguide, which directs the microwaves into the cavity. Waveguides are constructed of reflective material (i.e. sheet metal).

## Water/Dummy Load

A container filled with a volume of water that is placed in the microwave cavity to serve as an auxiliary load for reflected energy during processing. When the sample size is insufficient to affect impedance matching within the microwave cavity, energy is reflected in the microwave cavity. Under these conditions the microwave cavity is said to be mismatched due to the presence of reflected energy.