

高周波誘電・マイクロ波加熱 –Dielectric Heating /

【加熱原理】

高周波誘電・マイクロ波加熱はご家庭でご利用の電子レンジと同じ加熱原理です。ただし”水分”が含まれないと加熱できないと思われがちですがそんなことはありません。

右の図は高周波による誘電体の動きを表しています。

高周波誘電・マイクロ波加熱は、加熱物に高周波電界を印加すると誘電体を構成する双極子(ダイポール)が高速振動します。例えば27MHzの場合1秒間で27, 000, 000回、プラスとマイナスに位相が変化しますが、この電界の極性変化に対して双極子のプラス極とマイナス極が追従しようとし、振動が追いつかず振動遅れを生じます。

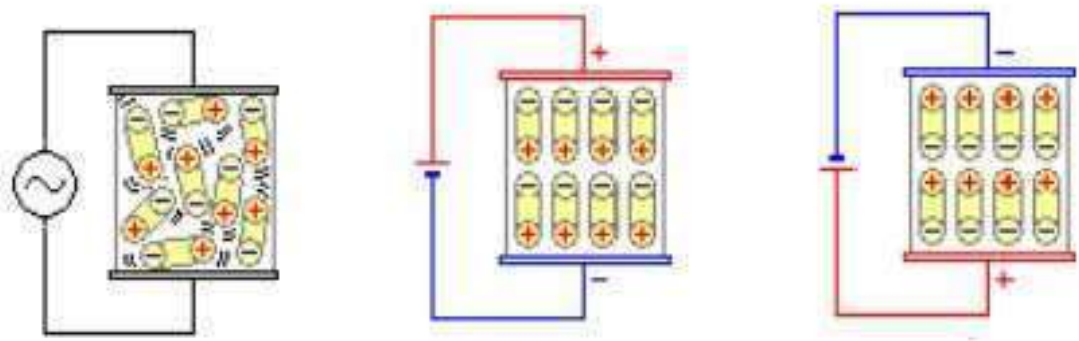
この振動遅れが位相差で誘電損失のある媒質中で減衰し、その損失分の発熱が起ります。(図1参照)

誘電加熱とマイクロ波加熱の周波数と波長は異なります

- ・誘電加熱 : 13.56、27.12、40.68MHz
- ・マイクロ波加熱 : 915MHz、2.45、5.8GHz

誘電加熱は電極で、マイクロ波加熱は無電極で加熱します。

対象の成分や形状、加熱部位等で周波数や電極形状を検討します。



(a) 無電圧 → (b) 電圧プラス ⇔ (C) 電圧マイナス
(a) no voltage → (b) voltage + ⇔ (C) voltage -

【図1】誘電体中のダイポールの動き
【Fig.1】Dipole motion in a dielectric

【Heating Principles】

Dielectric heating and microwave heating have the same heating principles as microwave ovens at home. Due to the common impression of microwave ovens, one is likely to think that it cannot be heated without “moisture” which is not the case.

The figure on the right shows the movement of dielectric dipoles due to high frequency. In dielectric heating and microwave heating, dipoles that from the dielectric vibrate at high speed because of the electric field, when a high-frequency electric field is applied to a heating object. For example, the phase alternates between positive and negative 27, 000, 000 times per second in the case of 27Mhz. The positive and negative poles of dipole attempt to follow the change in polarity of the electric field. However, the vibration cannot catch up with the speed of rotation, causing a vibration delay. This vibration delay attenuates in a medium with dielectric loss due to the phase difference, and heat is generated for that loss. It should be noted that the frequency and wavelength differ between dielectric heating and microwave heating. (Refer to Fig. 1)

- Dielectric heating : 13.56MHz, 27.12MHz, 40.68MHz
- Microwave heating : 915MHz, 2.45GHz, 5.8GHz

While dielectric heating uses electrodes, microwaves heating employ electromagnetic waves to heat an object without electrodes. The frequency and the shape of electrode are determined by the composition and shape of the heated object or by the area that is heated.

【加熱の特長】

高周波誘電・マイクロ波加熱は対象を瞬時に自己発熱させるため生産性が高く、省エネルギー・クリーンな加熱として様々な市場で活用されています。

- 急速加熱 (加熱時間が短い)
対象が自己発熱し、熱伝導が不要なため短時間で内部加熱
- 内部加熱 (被加熱の内部まで加熱出来る)
対象全体で電磁波が熱に変換され、内部も加熱される
- 選択加熱 (エネルギー効率が低い)
損失の大きな対象を選択的に加熱し効率良く加熱
- 高い制御性
瞬時に起動停止。出力調整で温度コントロールも容易

【Features】

Dielectric and microwave heating are utilized in various markets for high productivity, Energy-saving and environmentally-friendly heating because both instantly make the target object heat itself.

- Rapid Heating (Short heating time)
The target object heats itself and no time for heat conduction is required, it can be heated to the inside in a short time.
- Internal Heating (Heating through the inside of the object)
Electromagnetic waves hit the entire target object where waves are converted to heat, which heat through to the inside.
- Selective Heating(High energy efficiency)
It efficiency heats the target object since it requires no heat conduction as well as selectively heats the object with large loss.
- High Controllability
It instantly starts and stops with an ON/OFF switch. Output adjustment also makes it easy to control the temperature.

【主な市場・目的】

- 目的
短時間昇温、内部加熱、溶着、成形、予熱、固着、解凍、殺菌、防黴、殺卵、膨化乾燥、焼結、接着、反応、分解、CVD、エッチング、クリーニング他
- 市場
自動車関連(各種自動車部品)、化学、樹脂、ゴム、繊維、食品、木材、印刷、セラミックス、食品サンプル、医療機器、事務用品、プラズマ、大学、各種公的研究機関、他

【Major target markets and objectives】

- Objectives
Quick temperature rise, Internal heating, Welding, Molding, Preheating, Vulcanization, Fixation, Thawing, Sterilization, Mold control, Eliminate insect eggs, Puffing dehydration, Sintering, Bonding, Chemical reaction, Decomposition, CVD (Chemical vapor deposition) Etching, Cleaning, etc.
- Target Markets
Automotive related (various automotive parts), Chemical related, Resin, Rubber, Textile, Food, Wood, Printing, Ceramics, Food sample, Medical equipment, Office supplies, Plasma, universities, Various public research institutes, etc.