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MICROWAVE-ASSISTED SYNTHESIS & GREENER WORLD: A REVIEW REPORT

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ABSTRACT

This review paper reports the Microwave-assisted solvent free synthesis and there advantages towards a cleaner and greener world. The Microwaves have wavelength in the range of 1 mm to 1 m, corresponding to frequencies between 30 and 3 GHz. Microwave heating is technique that involves electromagnetic waves and consequent heat transfer. When an electric field is applied to a conductive material it causes flow of electricity. Further, a time-varying electric field starts back and forth motions leading to oscillations in dipolar molecules, such as water etc. Similarly, the application of a time-varying magnetic field to a conductive material also induces current to flow. The popularity of microwave irradiation methodology is increasing rapidly as it opens new avenues from conventions heating technique to modern eco-friendly, cheaper, quicker and safer path way for solvent-free molecular synthesis. A scope of using a variety of supporting agents, and cycloaddition, cyclocondensation reactions has also been established.

KEYWORDS: Microwave heating, electromagnetic waves, dipolar molecules, cycloaddition, cyclocondensation.

INTRODUCTION

The use of Microwave heating technology is increasing very rapidly and popularly all over the world. This system of synthesis is very helpful in pharmaceutical and academic arena. It has gained the attention of researchers, environmental activists and innovators. Numerous papers have been written on its important role in drug discovery and development.[1]

Microwaves have wavelength in the range of 1 mm to 1 m, and corresponding frequencies between 30 and 3 GHz. As per the international standard and convention, the microwave frequencies at 2.45 GHz and 12.2 cm wavelength are used for industrial and scientific operations (figure 1[2]). Numerous Experimental data studies performed over more than ten years enlighten us about very exiting result that researchers have found that microwave-induced chemical synthesis rates can be faster than those of conventional heating methods by as much as 1,000-folds.[1]

The research work on microwave-assisted organic syntheses and publications are increasing very fast day by day with approximately more than 2500 publications on print after the pioneering work of **Gedye and Giguere** (1986).

Microwave Irradiation technique and heating effects

It has been experimentally observed and also found in research published that the 6–8 Simultaneous cooling of reacting being heated by microwave energy enables a greater amount of microwave energy to be introduced into the reaction. This result is helpful in keeping the reaction temperature low and leads to significantly greater yields and cleaner environment.

When microwave radiations are impinged on dielectric material, it plays in different ways. Some of the part of its energy is reflected by material, some get transmitted and a part of it is absorbed by the material and consequently dissipated as heat.

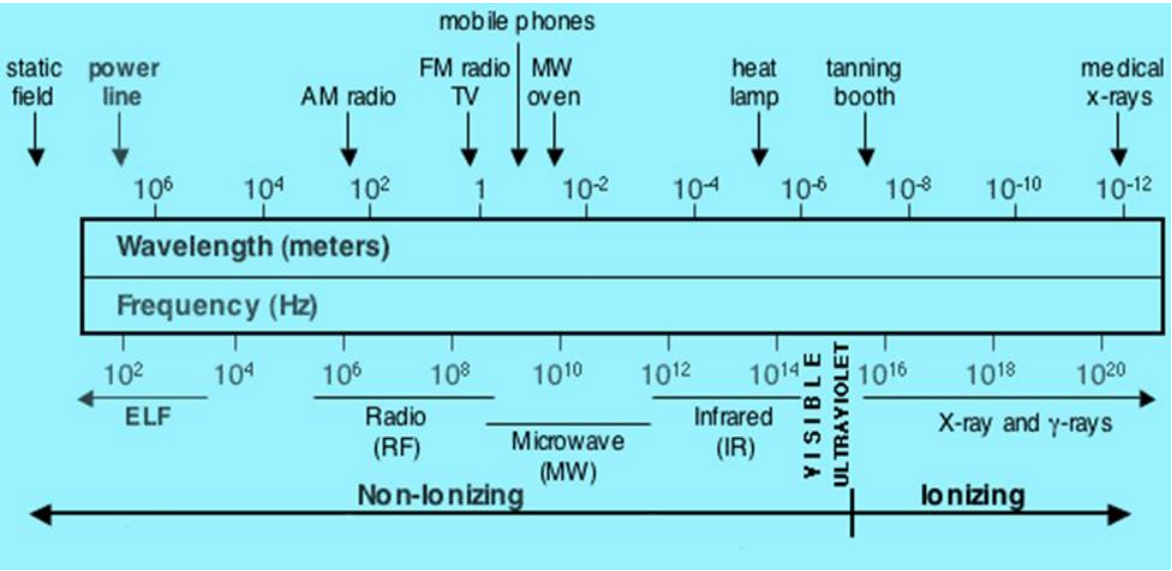

Figure 1[2]: Electromagnetic spectrum.

Mechanism and recent advancements

In conventional heating technique, the process is very slow. In this process, heat first reaches the walls of the vessel, and then slowly goes to the reaction mixture or solvent. Therefore, the transfer of energy from the source of the heat to the reacting substances is longer. It takes time, but in microwave irradiation, these are directly coupled with the molecules of the entire reaction mixture. As the molecules get direct contact with the microwave effects, reactions start rapidly because of heating effects. In general, two fundamental mechanisms are put forward for understanding the purpose of microwave heating technology, one is the dipole rotation and, the other is ionic conduction method.

The incident oscillating electric field when exposed and interacts with material, the dipoles tries to reorient themselves as per the external field lines. Therefore 'molecular friction' comes into existence and it produces heating effect. This energy does not affect molecular structure.

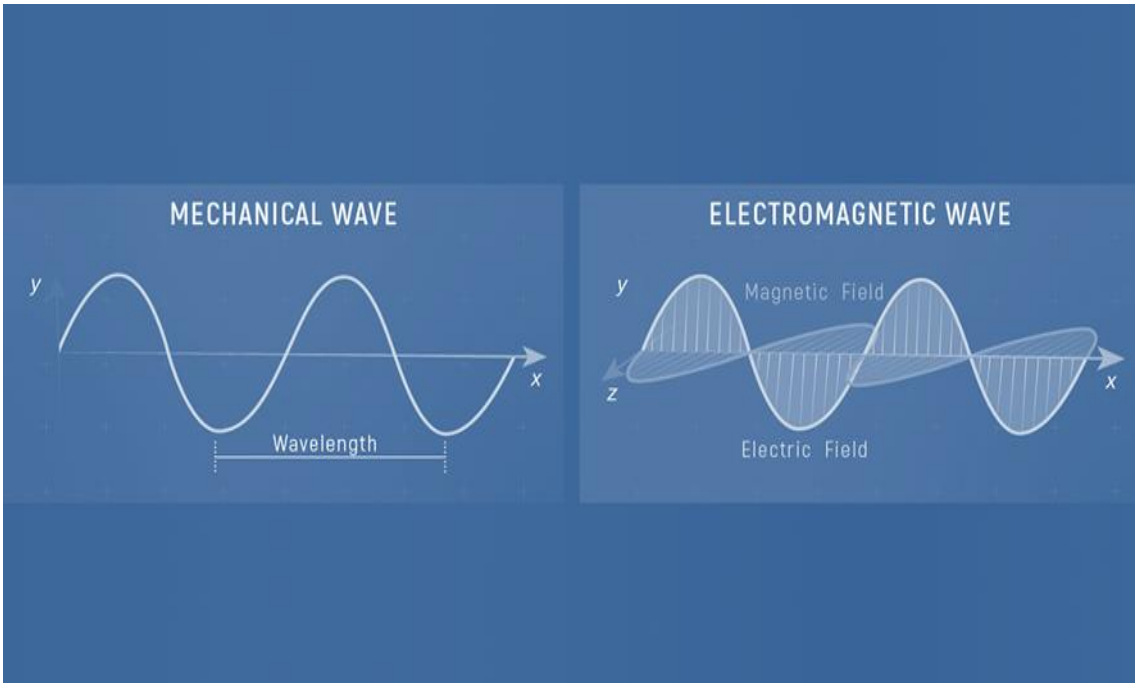

Figure 2[3]: Graphical representation of mechanical and electromagnetic waves.

In ionic conditions, completely dissolved charged particles start back and forth oscillations under the influence of microwave irradiations. During these oscillations, they collide with neighboring atoms or molecules. This whole process is ultimately responsible for generation of heat.

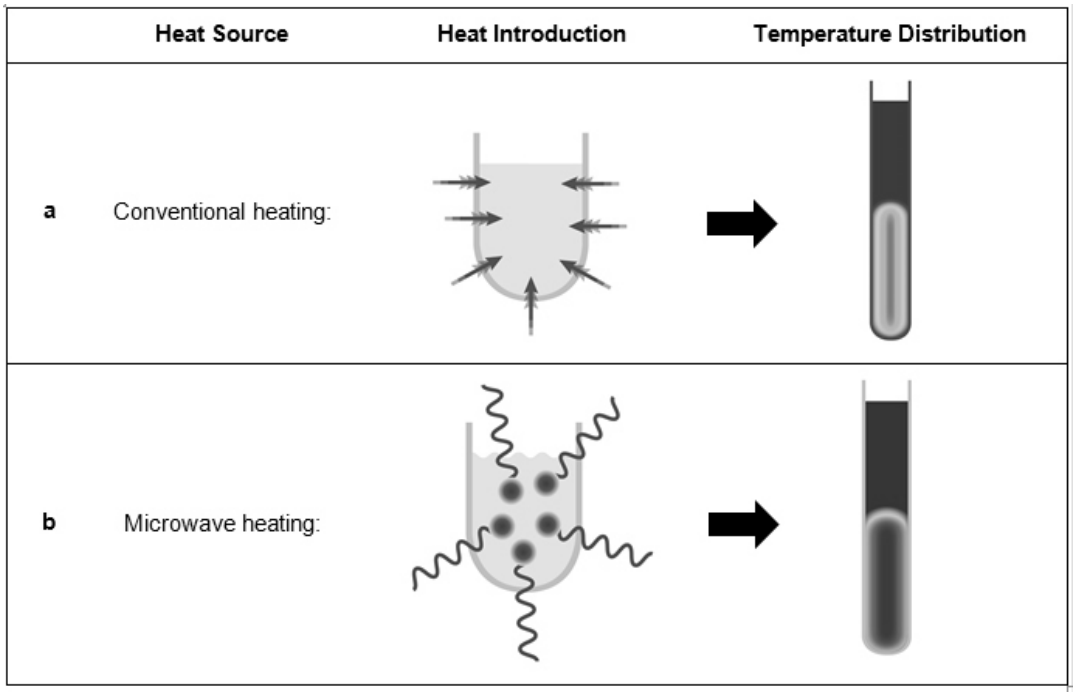

Figure 3[4]: mechanism of conventional and microwave heating.

Researchers have witnessed the ability of microwave technology to fasten the chemical synthesis processes and their strength to accelerate the yield of the reaction.[5]

Microwave assisted synthesis have attracted the attention of chemists across the world and newer molecules are synthesized frequently in easier manner.[6-25]

CONCLUSION

Evidently microwave-assisted synthesis has gained wider acceptance and adoption. This methodology is attracting newer researcher in this advancing field.

This review letter underlines the salient features and practical benefits of microwave-assisted synthesis, such as excellent yields, shorter reaction times, and enhanced reactivity.

Microwave technology has proved itself as need of the hour as is efficient to fight with the global hazards and has emerged as a tool towards keeping world greener. It is equally useful is in complex reactions and applied to drug discovery which shows its potential impact in the pharmaceutical industry.

As future prospective it is poised to become an indispensable tool in modern chemistry, paving the way for cleaner, faster, and much more efficient chemical transformations.

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