Application of Microwave-Assisted Photochemistry

***Pavel Müller**,*[a] Petr Klan,[a] Jaromir Literak,[a] and Vladimir Cirkva[b]*
[a] Department of Organic Chemistry, Faculty of Science, Masaryk University, Kotlarska 2, 611 37 Brno, Czech Republic.
[b] Institute of Chemical Process Fundamentals, Academy of Sciences of the Czech Republic, Rozvojova 135, 165 02 Prague 6, Czech Republic.

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Photochemistry in the microwave field presents a combined chemical activation by two distinctive kinds of electromagnetic radiation. Energy of MW radiation (E = 0.4–40 J.mol^{-1} at ν = 1–100 GHz) is considerably lower than that of UV-VIS radiation (E = 600–170 kJ.mol^{-1} at λ = 200–700 nm) and thus insufficient to disrupt bonds of common organic molecules. Molecules with a permanent (or induced) dipole respond to an oscillating microwave field by rotating, which results in friction with neighboring molecules and thereby in heat. On the other hand, the UV-VIS radiation can bring about electronic excitation of molecules and trigger their photochemical transformation.

The objective of photochemistry in the microwave field is frequently, but not irreplaceably, connected to the electrodeless discharge lamp (EDL), which generates UV radiation when placed into the MW field.

It was shown that the spectral output of the electrodeless discharge lamps depends on numerous factors such as temperature of the ambient environment, EDL envelope material, solvent used in a photochemical reaction, amount of the filling substance, and the intensity and the nature of the MW field.

Spectral characteristics of EDLs containing miscellaneous filling materials (measured under diverse conditions) are to be presented together with a brief discussion of the advantages and limitations of their use (sulfur EDLs may potentially be used for simulation of sunlight radiation in the laboratory experiments).

Since the application of EDLs in photochemistry is very simple, universal and accessible to a broad spectrum of chemists, it is likely to find its way into a conventional chemical laboratory.

References

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