Ohmic heating: a new tool for organic synthesis

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Some of the challenging actual topics for chemists, namely reduce energy consumption, replace toxic organic solvents and perform chemical transformations in aqueous media, prompted us to start a project aiming to construct and test an ohmic heating reactor for organic synthesis in aqueous media.

Ohmic heating is an advanced thermal processing method where the reaction mixture or the medium, which serves as an electrical resistor, is heated by passing electricity through it. The heating occurs in the form of internal energy transformation (from electric to thermal) within the reaction mixture. Therefore, ohmic heating can be seen as an internal thermal energy generation technology, and not only as a thermal energy transfer, meaning that it does not depend on the heat transfer to the medium. Thus, electrical energy is dissipated into heat with high efficiency. Some organic reactions were performed using the ohmic heating reactor as a proof of concept and the results, compared with those obtained under conventional (oil bath) and microwave heating, showed that the ohmic reactor allows faster and more uniform heating and induces the increase of dynamics/mobility of charged species, with a virtually unlimited penetration depth, on contrary to microwave heating, leading in several cases to higher reaction yields and shorter reaction times. Besides, its high efficiency, the possibility of fast and uniform heating, as well as the possibility of visual monitoring and addition of reagents during the reaction, which in most microwave closed cavities is not possible, make the use of this process a highly advantageous and versatile option for organic synthesis especially in water.

In addition to organic synthesis, this reactor and heating method can also be applied in inorganic synthesis, mainly in the synthesis of organometallic frameworks and nanoparticles.

Due to the easy scaling up of the reactor and heating process, this technology has real commercial potential in industry, particularly as more chemists start to exploit the high thermal capacity, low cost and non-toxic nature of on-water techniques.

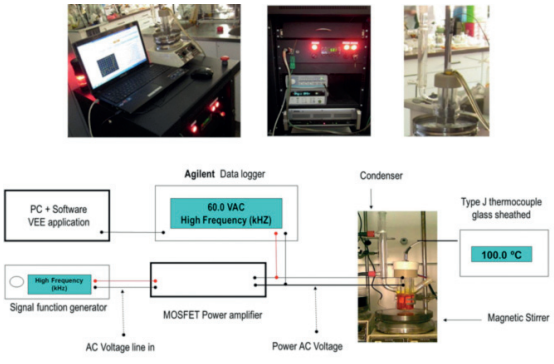

FIGURE 1
Schematic representation and pictures of the ohmic heating reactor (Portuguese Patent nº 105908, 2011-09-27)