

Microwave-assisted oxidation of n-pentane in air

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Microwave assisted catalysis is a fast, selective, volumetric and contactless method to activate catalysts. Thus, it is possible to only heat the catalytically active components, and not the bulk of the catalyst, the feed or the products [1, 2, 3]. This special form of non-classical energy input by microwave radiation still represents a fringe area of catalysis, alternative reaction and chemical and process engineering. However, this research area experiences a growing academic and industrial attractiveness. Multimode microwave ovens are especially suitable for heterogeneous catalysis. They have a larger microwave cavity than single-mode microwave ovens and they are considerably less expensive. In our investigation, we used a modified Panasonic NE-1846 microwave oven with two magnetrons, each having a microwave power of 900 watts. A switched-mode power supply was used to control the energy input. The temperature was controlled by an IR pyrometer and additionally by a thermocouple after switching off the magnetrons [4].

The oxidation of n-pentane in air has been carried out using a V₂O₅ – catalyst. The catalyst was composed of V₂O₅, a microwave - active compound, deposited on a microwave-transparent support such as Al₂O₃. With this kind of catalyst it is possible to form microscopic hot spots on the catalyst which can influence the product selectivity. Functional groups on the support play also an important role because they can be activated by microwave irradiation.

The microwave-assisted oxidation of n-pentane in air shows differences in conversion and selectivity compared to conventionally heated reactions. As reaction products CO₂, aldehydes, 2-methylfuran and 2-methylbutane are detected. The selectivity to CO₂ is smaller for the microwave-assisted reaction. There are two possible reasons for the differences in conversion and selectivity between the microwave –assisted and conventionally heated reaction: First, thermal effects, such as the different temperature regimes in the catalyst bed and hot spots due to the different activation of the catalyst when using microwave irradiation. Second, a few catalysts change their structure during microwave irradiation but not in the conventionally heated reaction.

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