

## Oxidation reactors with direct catalyst heating using microwaves

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In an ideal catalytic contactor, the energy necessary for the reaction would be exclusively delivered to the active sites of the catalyst. This ideal concept is in contrast with conventional operation of catalytic reactors, where heat is generally supplied through the reactor wall, leading to unnecessary heating of the fluid phase, catalyst support and reactor materials.

In contrast, direct catalyst heating would provide better energy efficiency, and a host of other benefits including a higher selectivity in series-parallel reacting networks with a valuable intermediate product, where further (unwanted) reaction would be prevented by the lower temperature of the surrounding gas stream.

In this talk, the concept of direct catalyst heating will be discussed, together with some of the practical challenges involved. Specific examples will be provided based on alternative heating modes that use microwaves (with zeolite and perovskite catalysts, and with microwave-sensitive supports), to attain direct catalyst heating. The concept will be applied to i) total combustion of traces of pollutants in air and ii) oxidative dehydrogenation reactions. Outstanding results have been obtained, especially in the oxidative dehydrogenation of isobutane using carbon dioxide (CODH) where selectivity gains of 25-30% have been obtained with respect to conventional reactors at the same conversion levels, thanks to the strong reduction of undesired homogeneous reactions in the gas phase.

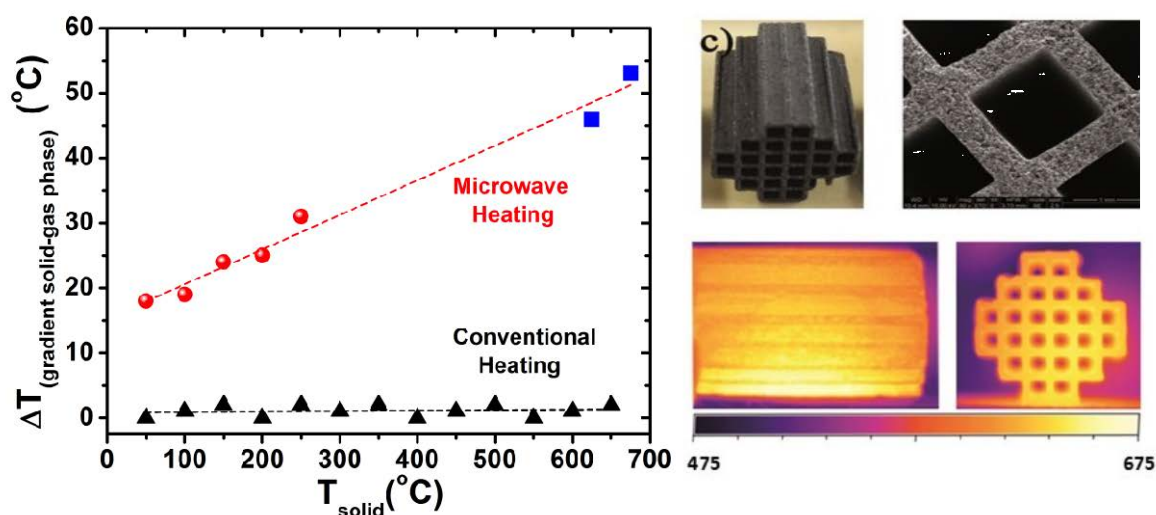


Figure. 1. Left: Temperature differences between the solid (a SiC monolith) and the gas phase when subjected to microwave heating (Isobutane oxidative dehydrogenation with CO<sub>2</sub>: 50 mL/min total; 20% isobutane, 10% CO<sub>2</sub>, 70% Helium). Right: Top Pictures of the MW-sensitive SiC monolith onto which the desired catalyst can be deployed. Bottom: SiC monolith heats homogeneously under MW irradiation (temperature scale from 475 to 675 °C).