

# Major Challenges and Recent Advances in Characterizing Biomass Thermochemical Reactions

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## Abstract

Thermochemical conversions are pathways for the utilization of biomass to produce a variety of value-added energy and chemical products. For the development of novel thermochemical conversion technologies, an accurate understanding of the reaction performance and kinetics is essential. Given the diversity of the thermal analysis techniques, it is necessary to understand the features and limitations of the reactors, ensuring that the selected thermal analysis reactor meets the specific need for reaction characterization. This paper provides a critical overview of the thermal analysis reactors based on the following perspectives: 1) gas flow conditions in the reactor, 2) particle's external and internal heat and mass transfer limitations, 3) heating rate, 4) temperature distribution, 5) nascent char production and reaction, 6) liquid feeding and atomization, 7) simultaneous sampling and analyzing of bed materials, and 8) reacting atmosphere change. Finally, prospects and future research directions in the development of thermal analysis techniques are proposed.

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