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**An Investigation of Optimal Parameters for Microwave-Assisted
Multicomponent Reactions (MCR)**

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ABSTRACT

Microwave-assisted multicomponent reactions (MCRs) have emerged as an efficient and sustainable approach in modern synthetic chemistry for the rapid construction of complex molecules. The investigation of optimal parameters for these reactions is essential to achieve higher yields, shorter reaction times, and improved selectivity. Microwave irradiation provides uniform heating and enhances molecular interactions, which significantly accelerates reaction rates compared to conventional heating methods. In optimizing microwave-assisted MCRs, several parameters must be carefully examined, including microwave power, reaction temperature, reaction time, solvent selection, catalyst type, and reactant concentration. The appropriate adjustment of microwave power and temperature helps in preventing thermal degradation of sensitive compounds while maintaining efficient reaction kinetics. Solvent choice also plays a crucial role, as polar solvents generally absorb microwave energy more effectively, leading to faster reaction progress. Additionally, the presence of suitable catalysts can enhance reaction efficiency and product formation. Systematic optimization through experimental design allows researchers to identify the most effective combination of these parameters for specific reactions. By optimizing these conditions, microwave-assisted MCRs can provide environmentally friendly and economically viable pathways for the synthesis of pharmaceuticals, agrochemicals, and functional materials. Thus, the study of optimal reaction parameters is fundamental for maximizing the advantages of microwave technology in multicomponent synthetic methodologies.