Carbonylation reactions in gas / liquid plasma microreactor using CO_2

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Carbonylation allows access to a lot of high added value organic molecules of biological interest, however it involves the use of carbon monoxide, a colorless, odorless, tasteless and highly toxic gas. On the contrary, carbon dioxide is a non-toxic, inexpensive and non-flammable gas. Its use as a raw material to produce CO in situ, without the latter being manipulated, is thus an attractive route to realize carbonylation reactions. But, the low reactivity of CO_2 implies a significant energy need for its transformation, which is often complex and costly to implement. Plasma has been demonstrated as a handful tool for CO_2 conversion [1-3]. In this study, CO_2 is first decomposed into CO by DBD plasma at room temperature and atmospheric pressure, then the CO thus formed is incorporated continuously by carbonylation into organic molecules of interest in the liquid phase. These two stages are carried out in two separate microreactors connected in series. Microfluidics allows both a better control of plasma generation by reducing energy losses, and improves the gas / liquid mass transfer thanks to the very high surface to volume ratio, resulting in a high reaction efficiency in a very short residence time, under mild conditions. In this way, the continuous production of CO in situ in a closed environment makes it possible to resolve the CO security constraints. Thus, flow chemistry, microfluidics and plasma are grouped here in a single tool dedicated to organic synthesis from CO_2.

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