Supported bismuth nanoparticles as upscalable and highly selective electrocatalyst for the conversion of CO_2 into formate

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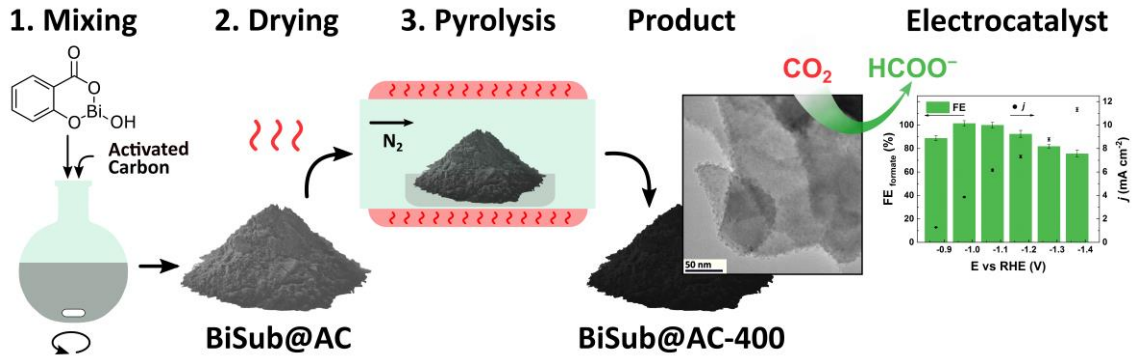
The electrochemical conversion of CO_2 into valuable products is an appealing technology for the mitigation of anthropogenic CO_2 emissions. Among the possible products that can be obtained through the electrochemical reduction of CO_2, formate is a relevant target owing to its high accessibility (2 e^- process) and its broad range of applications [1]. Here, we present a novel, straightforward and scalable synthesis procedure for preparing a highly selective electrocatalyst for the conversion of CO_2 into HCOOH. The synthesis involves the impregnation of a low-cost and abundant organic bismuth precursor (bismuth subsalicylate, *BiSub*) on activated carbon, followed by mild temperature pyrolysis (T = 400°C). The obtained *BiSub@AC-400* material consists of small and highly dispersed bismuth nanoparticles (d ≈ 6 nm – see TEM image below) supported on activated carbon (*AC*). The electrocatalyst showed complete selectivity towards the desired formate product ($FE_{formate}$ > 99%) at E = −1.07 V vs RHE in CO_2-saturated 0.5 M $NaHCO_3$ electrolyte (see figure below) and high stability, maintaining a current density of ~4 mA cm^{-2} at E = −0.97 V vs RHE for 48 h [1]. Currently, we are studying and will report the behaviour of this electrocatalyst under industrial relevant flow conditions (j > 100 mA cm^{-2}).



[1] M. Miola, B.C.A. de Jong, P.P. Pescarmona, *Chem. Commun.*, **2020**, *56*, 14992-14995.