Mechanochemical synthesis of biocompatible metal-organic frameworks and guest encapsulation

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With the growing emphasis on sustainable chemistry, the development of more efficient and environmentally synthetic routes to functional materials has become increasingly important. Mechanochemistry, which applies mechanical forces to trigger chemical reactions, is a highly efficient synthetic method that has yielded a wide range of metal-organic frameworks (MOFs) with different properties [1, 2]. In this work, we are investigating a class of biocompatible MOFs that are constructed from rigid phenolic organic linkers derived from plants, such as walnuts, pomegranates or wine, in conjunction with non-toxic metal centres. These MOFs can be synthesized from solution, but solubility concerns limit the possible inclusion of guests, and large amounts of liquid waste are created [3, 4]. Herein, we are showcasing the use of ball milling for the rapid synthesis of these highly porous MOFs, with minimal use of liquid additives. Given that mechanochemical products are intrinsically in powder form, powder X-ray diffraction measurements (PXRD) were performed throughout this work for product assessment. Furthermore, the MOF systems have been studied with *in situ* monitoring by synchrotron PXRD techniques, giving us insightful details of the kinetics of these ball milling reactions. Additionally, we present a solid-state strategy for the encapsulation of templating guest molecules within MOF pores to generate more stable composite materials. Overall, our herein presented mechanochemical-based synthetic methods can further promote greener and more efficient MOF synthesis, while the experimental conditions can be tailored to yield MOFs with intended properties.

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