Revelation of the molecular assembly of the Nanoporous Metal organic framework ZIF-8

Abstract

Crystalline nanoporous materials are one of the most important families of complex functional material. Many questions pertaining to the molecular assembly mechanism of the framework of these materials remain unanswered. Only recently has it become possible to answer definitively some of these questions by observation of growing nanoscopic surface features on metal organic frameworks (MOFs) through use of in situ atomic force microscopy (AFM). Here we reveal that a growth process of a MOF, zeolitic imidazolate framework ZIF-8, occurs through the nucleation and spreading of successive metastable unenclosed substeps to eventually form stable surface steps of the enclosed framework structure and that this process is reliant on the presence of nonframework species to bridge the developing pores during growth. The experiments also enable identification of some of the fundamental units in the growth process and the stable crystal surface plane. The former findings will be applicable to numerous nanoporous materials and support efforts to synthesize and design new frameworks and to control the crystal properties of these materials.