Superprotonic conductivity in a metalloporphyrin-based MOF

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MOF materials exhibit great potential for a broad range of applications taking advantage of the high surface area and pore sizes and tuneable chemistry[1]. In particular, metalloporphyrin-based MOFs are becoming of great importance in many fields due to the bioessential functions of these macrocycles that are being mimicked. On the other hand, during the last years, proton-conducting materials have aroused much interest, and those presenting high conductivity values are potential candidates to play a key role in some solid state electrochemical devices such as batteries and fuel cells[2]. In this way, using metalloporphyrins as building units we have obtained a new crystalline material with formula $[H(bipy)_2]_2[(MnTPPS)(H_2O)_2]\cdot 14H_2O$, where bipy is 4,4´-bipyidine and TPPS is the meso-tetra(4-sulfonatephenyl) porphyrin. The crystal structure was determined by single crystal X-ray diffraction and thermal characterization was carried out by thermogravimetric (TG/DSC) and X-ray thermodiffraction (XRTD) measurements. The compound shows a zig-zag water chain along the [100] direction located between the sulfonate groups of the porhyrin (Figure 1). Taking into account those structural features, the compound was tested for proton conduction showing values of $1x10^{-2}$ $S\cdot cm^{-1}$ at 40 ºC and 98% relative humidity which are remarkably high values.

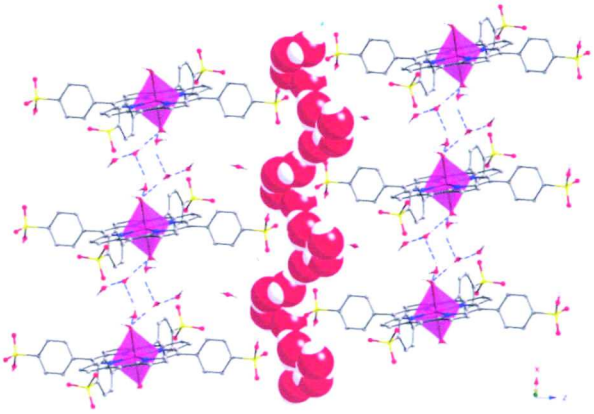

Figure 1. Zig-zag water chain and H-bonding system (doted lines) for compound $[H(bipy)_2]_2[(MnTPPS)(H_2O)_2]\cdot 14H_2O$.

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