Metal-organic framework supported 3D architecture of poly (1-vinyl imidazole) incorporated in sulfonated poly (ether ether ketone) matrix for fuel cell membrane applications.

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Metal-organic Frameworks (MOFs) are an interesting class of solid-state crystalline, porous materials with significantly high surface areas. Zirconium based microporous MOF 808 constructed from Zr_6 nodes ($Zr_6O_4(OH)_4$) and BTC (benzene-1,3,5-tricarboxylate) has been synthesized in this study. Further modification of the MOF was carried out by radical in situ polymerization using vinyl (1-imidazole) to design novel structures that were incorporated as hybrid fillers in sulfonated poly (ether ether ketone) (SPEEK) matrix to formulate composite PEMs by solution casting. The composite membranes displayed higher thermal stability, proton conductivity and fuel cell performance than pure SPEEK. The filler generates abundant proton conducting channels through the MOF pores and interacting sulfonic functional groups of SPEEK matrix causing the proton conductivity to increase by 5.13-fold higher than pure SPEEK. The membrane also retains sufficiently high proton conductivity at 100°C and low humidity indicating its superior proton conducting abilities. Furthermore, peak power density achieved by the membrane at 80°C is comparatively higher than many other reported literatures on SPEEK based membranes. The results give an overall insight that this kind of modified membranes can be potentially applied in PEM.