Characterization of Ionic Liquid Metal-Organic Framework Composite Materials

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Metal-organic frameworks (MOFs) are porous materials that have the promise of forming composite materials that exhibit unique properties when loaded with a "guest" molecule. In this study, we prepare a composite material of an ionic liquid (IL), 1-butyl-3-methylimidizolium bromide ([bmim]Br), melt loaded into a Zr-MOF (UiO-66), with the aim of elucidating IL–MOF interactions. PXRD analysis confirmed that the ionic liquid was successfully melt loaded into UiO-66 without compromising its crystallinity. Composites of 24%, 35%, and 40% by mass of IL–MOF were prepared. Peak shifts were observed in Raman spectra for the composites compared to UiO-66; most notably, we observe that the magnitude of C–C peak shift dependent on the mass fraction of IL in the composite, indicating IL interactions with the UiO-66 linker. Thermal analysis was employed to determine the maximum loading of [bmim]Br in UiO-66. Electrical conductivity of the three composites was measured to be 3.06×10^{-6} S/cm, 2.50×10^{-6} S/cm, and 3.19×10^{-5} S/cm for 24%, 35%, and 40% wt of IL respectively, each of which demonstrated a conductivity enhancement from the MOF alone. These findings demonstrate that melt loading of IL into UiO-66 could be an effective strategy for conductivity enhancement of Zr-MOFs, which are otherwise insulating materials.