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A novel hybrid decavanadate with a dicationic imidazolium ionic liquid

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Hybrid decavanadate ($[H_xV_{10}O_{28}]^{(6-x)-}$ or V_{10}) salts featuring organic cations are highly fascinating materials for diverse applications, such as gas adsorption and catalysis.[1,2] The direct reaction of the ionic liquid 1,1'-(1,4-phenylenebis(methylene))bis(3-methylimidazolium) bromide ($PhimBr_2$) with V_{10} in aqueous solution produced yellow crystals of a new compound $(Phim)_2[H_4V_{10}O_{28}]\cdot 6H_2O$ (**PhimV$_{10}$**, Figure 1). The product was characterized by infrared spectroscopy (IR), single-crystal and powder X-ray diffraction, elemental and thermogravimetric analysis (TGA). **PhimV$_{10}$** crystallizes in a triclinic space group, *P*–1 crystal system. The asymmetric unit contains half of tetra-protonated decavanadate, one **Phim^{2+}** cation and 3 water molecules. The supramolecular network is defined by an extensive net of weak to moderate hydrogen bonding (C···H—O and O···H—O) involving the V_{10}, water molecules and cations. **Phim^{2+}** are organized in pairs through a single π···π stacking interaction with a distance between centroids of 3.723 Å. The TGA showed a series of events corresponding to the loss of the 6 water molecules (Exp.7.02%; Theor. 6.73%) up to 150 °C and the thermal decomposition of the two **Phim^{2+}** cations (ca. 35% of weight loss) around 450 °C. Therefore, the sample was treated at 150 °C for 3 h prior the catalytic reaction to remove the water molecules. The IR spectrum of the reminiscent solid presented bands at 1556, 1153, 964 and 587 cm^{-1}, assigned to the ν(C–C), ν(C–N), ν(V=O) and ν(V–O–V) and the absence of bands expected for the water molecules. The catalytic performance for carbon dioxide fixation was investigated using propylene oxide and $ZnBr_2$ as co-catalyst. The preliminary catalytic results of **PhimV$_{10}$** exhibited moderate yield towards propylene carbonate (58%), highlighting its potential as a catalyst for CO_2 fixation into cyclic carbonates.

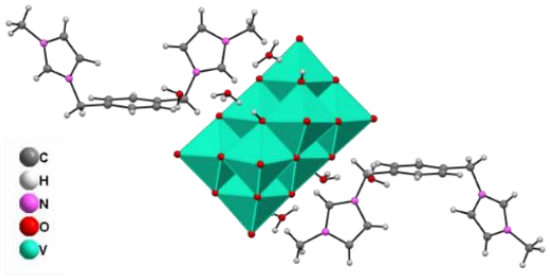

Figure 1: Polyhedral representation of $(C_{16}H_{20}N_4)_2[H_4V_{10}O_{28}]\cdot 6H_2O$.

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References

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