

containing polyoxotungstates precludes the closing of the Keggin unit and allows for the formation of many sandwich type structures. Among the well-known class of TM substituted sandwich POMs, Krebs-type polyanions $[M_4(H_2O)_{10}(\beta\text{-SbW}_9\text{O}_{33})_2]^{10-}$ [1] are good candidates for preparing hybrid compounds. Only a few hybrid structures derived from TM bi-substituted Krebs type POMs with a general formula $[(\text{TM-L})_2(\text{WO}_2)_2(\beta\text{-SbW}_9\text{O}_{33})_2]$ [2] (L=organic ligand) have been reported to our knowledge.

Here we report the synthesis, chemical and spectroscopic characterization and X-ray crystal structure of $\text{Na}_4\{[\text{Ni}(\text{L})(\text{H}_2\text{O})]_2(\text{WO}_2)_2(\beta\text{-SbW}_9\text{O}_{33})_2\}^+$ (Figure 1) comprises two $[\text{B-}\beta\text{-SbW}_9\text{O}_{33}]^{9-}$ components joined together *via* two $\{\text{WO}_2\}$ units and two octahedral coordinated Ni(II) ions forming a Krebs-type sandwich. Each Ni(II) ion is bonded to one O atom of one $[\text{B-}\beta\text{-SbW}_9\text{O}_{33}]^{9-}$ moiety and two O atoms of the other one. The coordination sphere is completed by the N, O-donor 4-imidazole carboxylic acid ligand and a water molecule. The crystal packing is built up by discrete molecular hybrid-POMs linked through the coordination sphere of Na cations showing corrugated layers parallel to the (101) plane. This arrangement creates channels along the [001] direction where almost all water molecules are located.

The structure of the polyoxoanion $\{[\text{Ni}(\text{L})(\text{H}_2\text{O})]_2(\text{WO}_2)_2(\beta\text{-SbW}_9\text{O}_{33})_2\}^+$ (Figure 1) comprises two $[\text{B-}\beta\text{-SbW}_9\text{O}_{33}]^{9-}$ components joined together *via* two $\{\text{WO}_2\}$ units and two octahedral coordinated Ni(II) ions forming a Krebs-type sandwich. Each Ni(II) ion is bonded to one O atom of one $[\text{B-}\beta\text{-SbW}_9\text{O}_{33}]^{9-}$ moiety and two O atoms of the other one. The coordination sphere is completed by the N, O-donor 4-imidazole carboxylic acid ligand and a water molecule. The crystal packing is built up by discrete molecular hybrid-POMs linked through the coordination sphere of Na cations showing corrugated layers parallel to the (101) plane. This arrangement creates channels along the [001] direction where almost all water molecules are located.

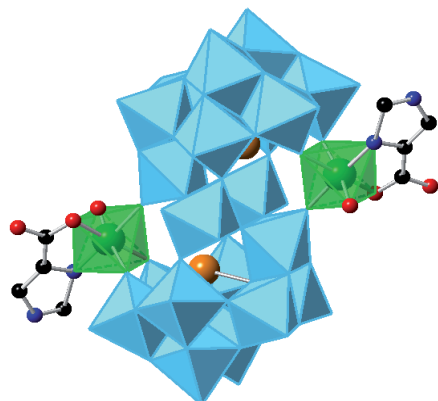


Figure 1. Hybrid POM $[\text{Ni}(\text{C}_4\text{H}_4\text{N}_2\text{O}_2)(\text{H}_2\text{O})]_2(\text{WO}_2)_2(\beta\text{-SbW}_9\text{O}_{33})_2^+$.

[1] M. Bosing, I. Loose, H. Pohlmann, B. Krebs, *Chemistry, European Journal*, **1997**, *8*, 1232-1237. [2] See for example, A. Dolbecq, J.-D. Compain, P. Mialane, J. Marrot, E. Rivière, F. Sécheresse, *Inorganic Chemistry* **2008**, *47*, 3371-3378.

Keywords: polyoxotungstate, hybrid, antimony.

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Inorganic-metalorganic hybrid compounds based on POMs and Cu-N₂Py₂ complexes

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It has been widely recognized that the polyoxometalates (POMs) exhibit a variety of structures and properties that make them useful in catalysis, material science and medicine [1]. Recently a new advance in the POM chemistry is that a large -number of hybrid compounds with unprecedented structures constructed from the combination of POMs and transition metal coordination complexes (TMCs) have been

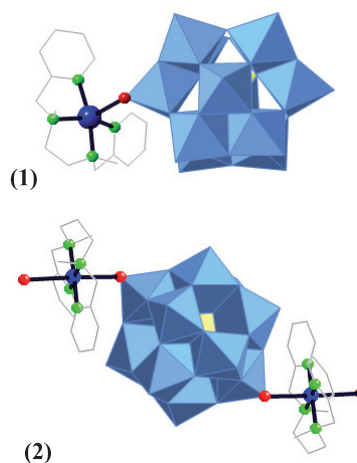
obtained [2]. An intelligent choice of POMs and TMCs may yield materials with fascinating structures and desirable properties.

Currently, we are interested in exploring the applicability of Keggin-POMs and TM-N₂Py₂ complexes in the preparation of new hybrid compounds.

Here we report the synthesis, chemical and spectroscopic characterization, X-ray crystal structure, and magnetic properties of $[\text{Cu}(\text{bpmen})(\text{H}_2\text{O})][\text{SiW}_{12}\text{O}_{40}\{\text{Cu}(\text{bpmen})\}]$ (**1**) (bpmen: N,N'-Dimethyl-N,N'-bis(2-pyridylmethyl)ethylenediamine) and $[\text{Cu}(\text{bpmpn})(\text{H}_2\text{O})]_2[\text{SiW}_{12}\text{O}_{40}]\cdot\text{H}_2\text{O}$ (**2**) (bpmpn: N,N'-Dimethyl-N,N'-bis(2-pyridylmethyl)ethylenediamine). The compounds (**1**) and (**2**) are prepared by hydrothermal synthesis.

Compound (**1**) can be viewed as a sequence along the [001] direction of hybrid inorganic-metalorganic corrugated layers built of $[\text{SiW}_{12}\text{O}_{40}\{\text{Cu}(\text{bpmen})\}]$ chains, linked through the apical water molecule of the unsupported $[\text{Cu}(\text{bpmen})]$ and the axial oxygen atoms of supported $[\text{Cu}(\text{bpmen})(\text{H}_2\text{O})]$ complex.

Compound (**2**) present a 2D arrangement formed by layers parallel to (110) plane built of POMs linked both via copper complexes coordination sphere and water molecules.



[1] D.-L. Long, R. Tsunashima, L. Cronin, *Angew. Chem. Int. Ed.* **2010**, *49*, 2-25. [2] S. Reinoso, P. Vitoria, J.M. Gutiérrez-Zorrilla, L. Lezama, L. San Felices, J.I. Beitia, *Inorg. Chem.* **2005**, *44*, 9731.

Keywords: polyoxometalate, hybrid, tetradentate N₂Py₂ ligands

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Solid state arrangement of diruthenium tetracarboxylates and tetraamidates

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Diruthenium complexes of the type $[\text{Ru}_2\text{Cl}(\mu\text{-O}_2\text{CR})_4]$ (R = alkyl, aryl) have been intensively studied due to their interesting electronic and magnetic properties [1]. In these complexes, the ruthenium atoms are strongly bonded by four bridging carboxylate ligands, with one axial position occupied by a chloride ion. The chloride ligand of the $[\text{Ru}_2\text{Cl}(\mu\text{-O}_2\text{CR})_4]$ molecule is usually also bonded to the free axial