

1D and 2D polyoxometalate-based composite compounds. Synthesis and crystal structure of $[\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}_2(\text{SiMo}_{12}\text{O}_{40})]$ and $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$

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Received 4th February 2002, Accepted 15th April 2002

First published as an Advance Article on the web 14th May 2002

The composites $[\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}_2(\text{SiMo}_{12}\text{O}_{40})]$ (**1**) and $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$ (**2**) have been synthesized and characterized by IR and UV spectroscopy, and single-crystal X-ray structural analysis. Compound **1** forms an unprecedented one-dimensional linear chain built from alternating polyanions and cationic units in the crystal, whereas crystalline **2** contains a novel two-dimensional network made up of polyanions, metal ions, H_2O , and DMSO. The chain and net are both connected through Mo–O_r–Ba–O–Ba links.

The design and assembly of organic–inorganic solid-state materials with active physical properties, such as materials with electrical, magnetic, and optical properties, has become a focus of a great deal of interest in recent years.¹ Many studies have shown that such properties are associated with structures constructed by so-called anion–cation salts or host–guest solids. In these fields, polyoxometalates have been found to be extremely versatile inorganic building blocks due to their ability to accept electrons. They can be combined with organic π -electron donors, such as tetrathiafulvalene (TTF)^{2–4} and bis(ethylene-dithio)tetrathiafulvalene (ET),^{5–8} to form polyoxometalate-based hybrid materials with 1D or 2D structures. Besides organic donors, other donor molecules, such as decamethylferrocene, can be combined with polyoxometalate acceptors.⁹ Furthermore, a type of intermolecular complex which can enhance SHG nonlinear optical response through electron transfer between organic and inorganic units has also been reported.¹⁰ The interactions existing in organic–inorganic or in organic–organic complexes are mainly facilitated by hydrogen bonds, van der Waals forces, and electrostatic forces in their structures. However, infinitely extended chains based on Keggin or Dawson-type anions, and joined together by W–O_r–M¹¹ links are relatively rare; a few notable examples include $[\text{ET}]_8[\text{PMnW}_{11}\text{O}_{39}] \cdot 2\text{H}_2\text{O}$,¹² $[\text{NET}_3\text{H}]_5[\text{XCOW}_{11}\text{O}_{39}] \cdot 3\text{H}_2\text{O}$ (X = P or As),¹³ $[\text{Co}(\text{dpa})_2(\text{OH})_2]_2[\text{Hdpa}][\text{PCoW}_{11}\text{O}_{39}]$, $[\text{Cu}(\text{en})_2(\text{OH})_2]_2[\text{H}_2\text{en}][\{\text{Cu}(\text{en})_2\}_2\text{P}_2\text{CuW}_{17}\text{O}_{61}] \cdot 5\text{H}_2\text{O}$ (en = ethylenediamine), and $[\text{Cu}(\text{en})_2(\text{OH})_2]_2[\text{Cu}(\text{en})_2]_{0.5}[\text{H}_2\text{en}]_{0.5}[\{\text{Cu}(\text{en})_2\}_2\text{P}_2\text{CuW}_{17}\text{O}_{61}] \cdot 5\text{H}_2\text{O}$ (M = Mn, Co or Cu),¹⁴ which are based on substituted polyoxometalate anions or synthesized by hydrothermal methods.

From the standpoint of molecular design, we have attempted to make use of simple syntheses to realize such molecular assemblies. One aim of introducing metal ions into the framework formed by polyanions and organic units is to combine polyanions with organic groups through metal ions and gain stable crystals. Another aim is to acquire information on the optical properties of these compounds, since polyoxometalate anions are good electron acceptors, while DMSO molecules are electron-rich donors, thus, they can interact, leading to electron transfer. Finally, the combination of heavy atoms with high oxidation states and reduced polyoxometalate anions to form mixed-valence compounds can lead to crystals which exhibit photochromism. Here, we report the syntheses and X-ray single-crystal structure analyses of two infinitely extended

polyoxometalate-based composites: $[\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}_2(\text{SiMo}_{12}\text{O}_{40})]$ (**1**) and $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$ (**2**). In their structures, the metal ions are firstly coordinated by DMSO, H_2O , and polyanion ligands to form a structure unit, then these structure units are connected through Ba–O–Ba–O_r–Mo links to construct one-dimensional chain-like or two-dimensional net-like structures. To our knowledge, the types of structures exhibited by **1** and **2** have never been reported previously. This paper focuses primarily on solid-state structural aspects of organic–inorganic complexes and reveals novel structures in which infinite stacking assemblies between polyanions and cationic units are achieved. The structures of the title compounds may serve as useful models for the design of functional molecular assemblies.

Experimental

Synthesis

All organic solvents and materials used for the synthesis were of reagent grade and were used without further purification. $\alpha\text{-H}_4\text{SiMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$ and $\alpha\text{-H}_4\text{GeMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$ were prepared according to the literature method.¹⁵

1 $[\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}_2(\text{SiMo}_{12}\text{O}_{40})]$ (**1**). The formation of the heteropolyacid barium salts was carried out by neutralization of the acids. $\text{H}_4\text{SiMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$ (5 g, 2.5 mmol) was dissolved in 20 mL water, and $\text{BaCl}_2 \cdot 2\text{H}_2\text{O}$ (1.1 g, 4.5 mmol) was added at 90 °C with stirring until the solution was nearly dry. The solids were isolated and dried on a fritted-glass funnel for next stage. Dried powder (2 g) from the first stage was dissolved in 10 mL acetonitrile–water mixture (5 : 2 v/v), and 1 mL DMSO was added at 70 °C with stirring, the mixture was allowed to react for 15 min. After cooling to room temperature, the solution was filtered and left to evaporate at room temperature. Three days later, yellow crystals were obtained; yield based on $\alpha\text{-H}_4\text{SiMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$: 60%. Elemental analysis: C obs. 8.62 (calc. 8.24), H 1.92 (2.1)%.

2 $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$ (**2**). Compound **2** was prepared using a similar method to that employed for the synthesis of **1**, with $\text{H}_4\text{GeMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$ (5 g, 2.6 mmol) in place of $\text{H}_4\text{SiMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$. Yellow crystals were obtained; yield based on $\alpha\text{-H}_4\text{GeMo}_{12}\text{O}_{40} \cdot n\text{H}_2\text{O}$: 40%. Elemental analysis: C obs. 6.68 (calc. 6.78), H 1.45 (1.96)%.

in Fig. 1. The site symmetry $\bar{1}$ is incompatible with the apparent tetrahedral symmetry of the Keggin structure.^{17,18} The Si atom is located at an inversion center (0.5, 0.5, 0.5). Therefore, the structure of **1** has the central Si atom surrounded by a cube of eight oxygen atoms and the Mo atoms situated at the corners of a regular cubooctahedron. The Si–O distances (1.565–1.697 Å) are consistent with the results of previous studies.^{19,20} The Mo–O distances vary over the very wide range 1.650–2.485 Å. The shortest Mo–O distances for the unshared oxygen atoms are in the range 1.650–1.662 Å, the mean value of 1.656 Å is 0.012 Å longer than that of the literature,¹⁹ the longest Mo–O

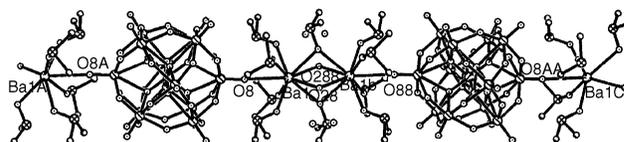


Fig. 3 View of the one-dimensional chain in **1**. The H atoms and the lattice water are omitted for clarity.

Table 2 Selected bond lengths (Å) and angles (°) for **1**^a

Mo(1)–O(4)	1.803(5)	Mo(1)–O(14)	1.797(5)
Mo(1)–O(19)	2.024(5)	Mo(1)–O(17)	2.016(5)
Mo(2)–O(7)	1.801(6)	Mo(2)–O(17)	1.808(5)
Mo(2)–O(5)#1	2.004(6)	Mo(2)–O(18)	2.007(5)
Mo(3)–O(10)	1.806(5)	Mo(3)–O(18)	1.803(5)
Mo(3)–O(9)#1	2.017(5)	Mo(3)–O(14)	2.011(5)
Mo(4)–O(5)	1.795(6)	Mo(4)–O(6)	1.816(5)
Mo(4)–O(4)	1.989(6)	Mo(4)–O(13)#1	2.003(5)
Mo(5)–O(21)	1.800(5)	Mo(5)–O(19)	1.800(6)
Mo(5)–O(10)#1	2.011(6)	Mo(5)–O(6)	2.000(5)
Mo(6)–O(9)	1.799(6)	Mo(6)–O(13)	1.803(6)
Mo(6)–O(7)	1.998(6)	Mo(6)–O(21)	2.020(5)
Ba(1)–O(24)	2.639(6)	Ba(1)–O(27)	2.683(7)
Ba(1)–O(26)	2.700(6)	Ba(1)–O(25)	2.766(6)
Ba(1)–O(23)	2.831(5)	Ba(1)–O(23)#2	2.889(5)
Ba(1)–O(1W)	2.911(5)	Ba(1)–O(1W)#2	2.929(5)
Ba(1)–Ba(1)#2	4.1930(10)	O(8)–Ba(1)–Ba(1)#2	176.60(8)

^a Symmetry transformations used to generate equivalent atoms: #1 $-x + 1, -y + 1, -z + 1$; #2 $-x + 2, -y + 2, -z + 1$. Mo–O bond lengths are selected from Mo–O_{b/c}.

Table 3 Selected bond lengths (Å) and angles (°) for **2**^a

Mo(1)–O(32)	1.843(4)	Mo(1)–O(26)	1.831(4)
Mo(1)–O(2)	2.049(4)	Mo(1)–O(28)	2.047(4)
Mo(2)–O(4)	1.856(4)	Mo(2)–O(10)	1.838(4)
Mo(2)–O(13)	2.038(4)	Mo(2)–O(5)	2.018(4)
Mo(3)–O(17)	1.863(4)	Mo(3)–O(2)	1.824(4)
Mo(3)–O(4)	2.054(4)	Mo(3)–O(33)	2.019(4)
Mo(4)–O(19)	1.846(4)	Mo(4)–O(5)	1.829(4)
Mo(4)–O(14)	2.056(4)	Mo(4)–O(34)	2.053(4)
Mo(5)–O(28)	1.857(4)	Mo(5)–O(22)	1.837(4)
Mo(5)–O(23)	2.024(4)	Mo(5)–O(21)	2.009(4)
Mo(6)–O(29)	1.869(4)	Mo(6)–O(14)	1.825(4)
Mo(6)–O(20)	2.035(4)	Mo(6)–O(10)	2.023(4)
Mo(7)–O(13)	1.858(4)	Mo(7)–O(15)	1.822(4)
Mo(7)–O(17)	2.046(4)	Mo(7)–O(22)	2.039(4)
Mo(8)–O(21)	1.855(4)	Mo(8)–O(25)	1.839(4)
Mo(8)–O(15)	2.050(4)	Mo(8)–O(19)	2.035(4)
Mo(9)–O(20)	1.851(4)	Mo(9)–O(33)	1.837(4)
Mo(9)–O(26)	2.037(4)	Mo(9)–O(35)	2.031(4)
Mo(10)–O(23)	1.861(4)	Mo(10)–O(7)	1.823(4)
Mo(10)–O(32)	2.049(4)	Mo(10)–O(24)	2.032(4)
Mo(11)–O(34)	1.840(4)	Mo(11)–O(8)	1.830(4)
Mo(11)–O(7)	2.053(4)	Mo(11)–O(25)	2.039(4)
Mo(12)–O(35)	1.849(4)	Mo(12)–O(24)	1.847(4)
Mo(12)–O(29)	2.055(4)	Mo(12)–O(8)	2.025(4)
O(6)–Ba(1)	2.782(4)	O(12)–Ba(2)	2.934(4)
O(31)–Ba(1)#1	2.903(4)	Ba(1)–O(48)	2.669(5)
Ba(1)–O(45)	2.676(5)	Ba(1)–O(42)	2.722(4)
Ba(1)–O(43)	2.822(4)	Ba(1)–O(41)	2.876(4)
Ba(1)–O(31)#2	2.903(4)	Ba(1)–O(1W)	2.925(5)
Ba(1)–O(4W)#3	2.927(5)	Ba(1)–Ba(2)#3	4.4043(14)
Ba(2)–O(46)	2.684(6)	Ba(2)–O(44)	2.756(5)
Ba(2)–O(43)#3	2.780(4)	Ba(2)–O(47)	2.825(5)
Ba(2)–O(3W)	2.829(5)	Ba(2)–O(41)#3	2.847(4)
Ba(2)–O(2W)	2.866(5)	Ba(2)–O(4W)	2.924(5)
Ba(2)–Ba(1)#3	4.4043(14)	O(6)–Ba(1)–Ba(2)#3	77.34(8)
O(31)#2–Ba(1)–Ba(2)#3	169.64(8)	O(12)–Ba(2)–Ba(1)#3	146.64(8)

^a Symmetry transformations used to generate equivalent atoms: #1 $-x, y - 1/2, -z + 3/2$; #2 $-x, y + 1/2, -z + 3/2$; #3 $-x - 1, -y, -z + 1$. Mo–O bond lengths are selected from Mo–O_{b/c}.

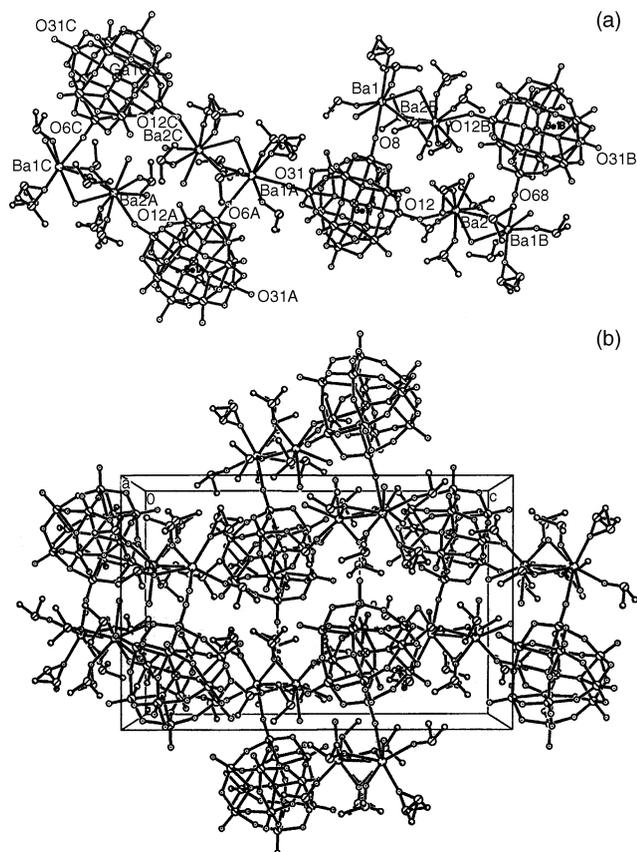


Fig. 4 (a) The connections between $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$ units in **2**. (b) View of the two-dimensional network along the a axis in **2**. The H atoms and the lattice water are omitted for clarity.

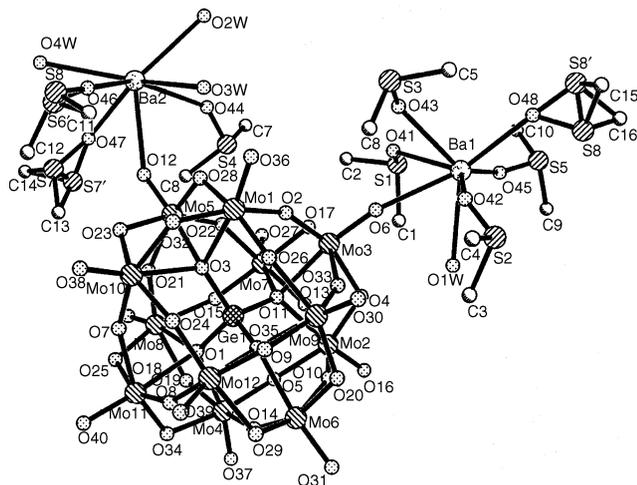


Fig. 5 Molecular structure unit of compound **2**. The hydrogen atoms are omitted for clarity.

different numbers of each ligand. Ba2 is linked to five DMSO molecules, three water, and a polyanion. In the $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]_2$ unit, four metal ions all bind with O_t atoms of polyanions; two $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]$ molecular units are in inverse sites, and four polyanions are bridged by a pair of Ba–O–Ba– O_t –Mo links, producing a square-like structure [Fig. 4(a)]. It should be noted that the connection between barium ions in **2** relies on three bridging O atoms, one from water, and two from DMSO molecules (Fig. 6). The non-bonding Ba \cdots Ba distance is 4.4043 Å. Finally, the $[\{\text{Ba}(\text{DMSO})_3(\text{H}_2\text{O})_3\}\{\text{Ba}(\text{DMSO})_5(\text{H}_2\text{O})\}(\text{GeMo}_{12}\text{O}_{40})]_2$ units are connected through a common oxygen atom from a polyanion, completing the construction of an infinite network. Here, it should be emphasized that, in **2**, three terminal oxygen atoms of each

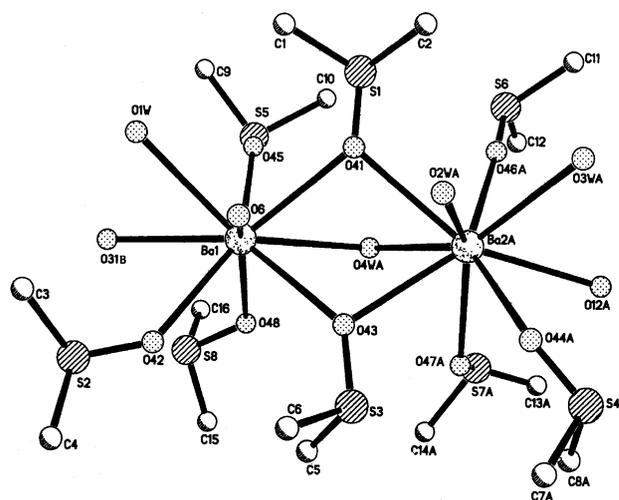


Fig. 6 Coordination environment of Ba^{2+} in **2**.

polyanion participate in coordination with Ba^{2+} ions, and their roles are all different.

In structure **2** (Fig. 5), the GeO_4 tetrahedron is almost regular. The Ge–O distances (1.731–1.739 Å) and O–Ge–O angles (109.29–109.74°) are in good agreement with values found in earlier investigations.^{21–23} In the MoO_6 octahedra, the Mo–O_t , Mo–O_a , Mo–O_b , Mo–O_c bond distances fall in the ranges 1.682–1.699, 2.275–2.314, 1.822–1.869, and 2.009–2.056 Å, and the mean values are 1.69, 2.3, 1.842, and 2.038 Å, respectively. All these values, except those for the Mo–O_c bonds, are also in accord with the results of other investigations.^{21–23} The mean value of the Mo–O_c distances is 0.022 Å shorter than that reported in the literature,²¹ corresponding to the decrease of the Mo–O_c band in the IR spectrum of **2**. In conclusion, the MoO_6 octahedra become thinner and longer because of the influence of the outer coordination environment of the polyanion.

Comparing **2** with **1**, the striking differences lie in that three terminal oxygen atoms of each polyanion participate in coordination with barium ions in **2**, whereas only two terminal oxygen atoms do so in **1**; two Ba^{2+} ions are situated separately on the same side of each polyanion in **2**, while they are located on opposite sides of the polyanion in **1**. Obviously, these differences result in the formation of different structures, a two-dimensional network for **2** and a one-dimensional chain for **1**. It is these kinds of differences, as well as the interaction between the cationic groups and polyanions, that cause the subtle changes to the structure of the polyanions. First, the SiO_4 tetrahedron in **1** is distorted, while the GeO_4 tetrahedron in **2** is regular. Second, the Mo–O distance (1.654 Å) for the oxygen atom coordinated with a barium ion in **1** is shorter than the other M– O_t distances, except for Mo1–O16 (1.695 Å), are longer than the other M– O_t distances, except for Mo3–O6 (1.686 Å). The third difference is that the connection between the Ba^{2+} ions relies on three bridging oxygen atoms in **2**, but four in **1**. The main analogies between **1** and **2** are that the Mo– O_c distances are shortened in both to some extent; the chain and net structures of compounds **1** and **2** both have Mo– O_t –Ba links, which are also exhibited in $[\text{ET}]_8[\text{PMnW}_{11}\text{O}_{39}] \cdot 2\text{H}_2\text{O}$, $[\text{NET}_3\text{H}_5][\text{XCoW}_{11}\text{O}_{39}] \cdot 3\text{H}_2\text{O}$, $[\text{Co}(\text{dpa})_2(\text{OH})_2][\text{Hdpa}][\text{PCoW}_{11}\text{O}_{39}]$, $[\text{Cu}(\text{en})_2(\text{OH}_2)_2][\text{H}_2\text{en}][\{\text{Cu}(\text{en})_2\}_2\text{P}_2\text{CuW}_{17}\text{O}_{61}] \cdot 5\text{H}_2\text{O}$, and $[\text{Cu}(\text{en})_2(\text{OH}_2)_2][\text{Cu}(\text{en})_2]_{10}[\text{H}_2\text{en}]_{10}[\{\text{Cu}(\text{en})_2\}_2\text{P}_2\text{CuW}_{17}\text{O}_{61}] \cdot 5\text{H}_2\text{O}$, whose polyanions units are bridged by W– O_t –M (M = Mn, Co, and Cu) sequences, forming chain-like structures.^{12–14} However, it is noteworthy that, unlike these compounds in which the chains are solely linked through W– O_t –M (M = Mn, Co, and Cu) bonds, the links in compounds **1** and **2** include Mo– O_t –Ba and Ba–O–Ba sequences. The M'– O_t –M–O–M (M = Ba, M' = Mo) links in compounds **1** and

2 are very interesting: firstly because polyoxometalates as ligands are electron acceptors which, in some cases, can be reduced by one or more electrons, giving rise to mixed valency clusters. This enables the formation of hybrid materials in which delocalized electrons coexist in both the organic network and the inorganic clusters. Secondly, if magnetic atoms are introduced into the structures of compounds **1** and **2**, it should be possible to produce novel solid-state materials in which delocalized electrons coexist with localized magnetic moments, thus affording the opportunity for the investigation of molecular systems combining magnetic and conducting properties. We are currently exploring these avenues. In this survey, the Ba–O distances found in both **1** and **2** are well within the ranges reported for comparable barium complexes, except for Ba1–O8 (3.042 Å) in **1**, which is longer than observed previously.^{24,25}

In addition, all the sulfur atoms in **1** and S6, S7, and S8 in **2** are all crystallographically disordered. The S–O distances for **1** and **2** lie in the ranges 1.335–1.584 and 1.408–1.606 Å, respectively. In the case of the bridging μ -O coordination of DMSO, the S–O distances are within the range 1.50–1.56 Å.^{26–28} We observed in the crystal structures of **1** and **2** that there are not only some shortened, but also some elongated S–O distances relative to that in the free DMSO molecules (1.513 Å).²⁹ However, there is only one band at 1024 cm⁻¹ in the IR spectra of **1** and **2**. The differences in the bond lengths may be partially caused by the disordered S atoms, and other reasons, as pointed out by the literature:³⁰ because of the large uncertainties, these distances do not differ in a statistically significant sense. We observed that there is no direct contact between the polyanions and DMSO ligands, but they can interact through the barium ions.

In the IR spectra of **1** and **2**, there are four characteristic asymmetric vibrations resulting from heteropolyanions with the Keggin structure, namely, $\nu_{\text{as}}(\text{Mo}=\text{O}_t)$, $\nu_{\text{as}}(\text{Mo}-\text{O}_b)$, $\nu_{\text{as}}(\text{Mo}-\text{O}_c)$, and $\nu_{\text{as}}(\text{X}-\text{O}_a)$ (X = Si, Ge). The peaks appear at 943, 865, 794, and 896 cm⁻¹, respectively, for **1** and 946, 855, 777, and 900 cm⁻¹, respectively, for **2**. Comparing the IR spectra of compounds **1** and **2** with those of $\alpha\text{-H}_4\text{SiMo}_{12}\text{O}_{40}$ and $\alpha\text{-H}_4\text{GeMo}_{12}\text{O}_{40}$,¹⁵ the peak due to the Mo=O_t bonds shifted from 957 to 943 cm⁻¹ for **1** and from 951 to 946 cm⁻¹ for **2**; the Mo–O_c bond vibrations are shifted from 770 to 794 cm⁻¹ for **1** and from 760 to 777 cm⁻¹ for **2**; the X–O_a and Mo–O_b bands appear at nearly identical frequencies to those found for $\alpha\text{-H}_4\text{SiMo}_{12}\text{O}_{40}$ and $\alpha\text{-H}_4\text{GeMo}_{12}\text{O}_{40}$. These results indicate that the polyanions in the title compounds still retain the basic Keggin structure, but are distorted due to the effects of coordination. This is in agreement with the results of the single-crystal X-ray diffraction analyses. In addition, the resonances at 1024 and 706 cm⁻¹ in compounds **1** and **2** were assigned to the $\nu_{\text{as}}(\text{S}=\text{O})$ and $\nu_{\text{as}}(\text{C}-\text{S})$ asymmetric stretching vibrations of DMSO molecules. Comparing the IR spectra of **1** and **2** with that of free DMSO,²⁹ $\nu_{\text{as}}(\text{S}=\text{O})$ decreases by approximately 30 cm⁻¹, from 1055 to 1024 cm⁻¹, in both **1** and **2**. This result confirms that the DMSO as ligands are coordinated to the metal ions by means of their oxygen atoms.³⁰ The $\nu_{\text{as}}(\text{C}-\text{S})$ frequencies in both compounds rise slightly by approximately 8 cm⁻¹, from 698 to 706 cm⁻¹. This can be explained by the fact that the charge density over the oxygen and sulfur atoms is decreased due to the O atoms of the S=O bonds being coordinated to barium ions, leading to an increase in the electron-donating effect of the methyl groups. The IR spectra studies indicate that there is strong interaction between the polyanions and organic groups in solid state.

The UV spectra of compounds **1** and **2** measured in aqueous acetonitrile solution are both similar to those of $\alpha\text{-H}_4\text{SiMo}_{12}\text{O}_{40}$ and $\alpha\text{-H}_4\text{GeMo}_{12}\text{O}_{40}$ in the same solution. Only one absorption peak, appearing at 235 nm in the UV region was observed in the UV spectra of these compounds, which is assigned to the charge-transfer absorption band of the polyanion. This suggests that the compounds are entirely disruptive in dilute solution. This was observed in a previous paper too.¹⁰

Conclusion

Two novel 1D and 2D polyoxometalate-based composite compounds have been synthesized and their structures elucidated by single-crystal X-ray diffraction. In their structures, the heteropolyanions are connected through Ba–O–Ba–O_c–Mo links, resulting in the one-dimensional chain-like and two-dimensional net-like arrangements.

Acknowledgements

This work was supported by the Natural Science Foundation of Henan Province and the Outstanding Youth Foundation of Henan Province.

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