

PGMs IN THE LAB

Platinum Group Metals in Polyoxometalates

Johnson Matthey and Alfa Aesar support new platinum group metals research

Here another researcher whose work has benefited from the support of Johnson Matthey and Alfa Aesar, A Johnson Matthey Company, is profiled. Ulrich Kortz is a Professor of Chemistry at Jacobs University in Bremen, Germany, and he is interested in the synthesis and characterisation of noble metal-containing polyoxometalates.

About the Research

Polyoxometalates (POMs) are a large class of discrete, soluble metal-oxo anions of early transition metals in high oxidation states, such as tungsten(VI) or molybdenum(VI). Due to a unique combination of properties, such as thermal and oxidative stability, tunability of acidity and redox activity, solubility in various media, and ability to undergo multistep multi-electron transfers without structural changes, POMs keep attracting more and more attention in different areas of fundamental and industrial science, in particular in homogeneous and heterogeneous catalysis.

Kortz's group are world leaders in the synthesis and characterisation of noble metal-containing polyanions. They prepared the first example of a Pt(IV)-containing polyoxovanadate, $[\text{H}_2\text{Pt}^{\text{IV}}\text{V}_9\text{O}_{28}]^{5-}$ by a facile synthetic procedure, using the Pt(IV) precursor $\text{H}_2\text{Pt}(\text{OH})_6$. The polyanion $[\text{H}_2\text{Pt}^{\text{IV}}\text{V}_9\text{O}_{28}]^{5-}$ was characterised in the solid state by X-ray diffraction (XRD) and in solution by ^{195}Pt and ^{51}V NMR spectroscopy.

Their research also includes the first example of a Pd(II)-containing heteropolyoxometalate, $[\text{Cs}_2\text{Na}(\text{H}_2\text{O})_{10}\text{Pd}_3(\alpha\text{-Sb}^{\text{III}}\text{W}_9\text{O}_{33})_2]^{9-}$ which consists of two $(\alpha\text{-SbW}_9\text{O}_{33})$ moieties linked by three square planar-coordinate Pd^{2+} ions resulting in a sandwich type structure (**Figure 1(a)**). The central belt is completed by two Cs^+ and a Na^+ ion which occupy the vacancies between the adjacent Pd centres, resulting in a polyanion with idealised C_{2v} symmetry (**Figure 1(b)**).

Kortz's group have pioneered the class of polyoxopalladates with the discovery of

About the Researcher

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$[\text{Pd}^{\text{II}}_{13}\text{As}^{\text{V}}_8\text{O}_{34}(\text{OH})_6]^{8-}$, which has the shape and dimensions of a molecular nanocube (**Figure 2**). Meanwhile the same group has isolated several other polypalladate derivatives of various shapes, sizes and compositions. Kortz's group has also pioneered the class of polyoxoaurates with the discovery of $[\text{Au}^{\text{III}}_4\text{As}^{\text{V}}_4\text{O}_{20}]^{8-}$. The Se(IV) derivative of this polyanion has also been reported very recently.

Polyoxo-noble-metalates can be used in a wide range of applications such as catalysis, analysis, medicine, biochemistry and materials science.

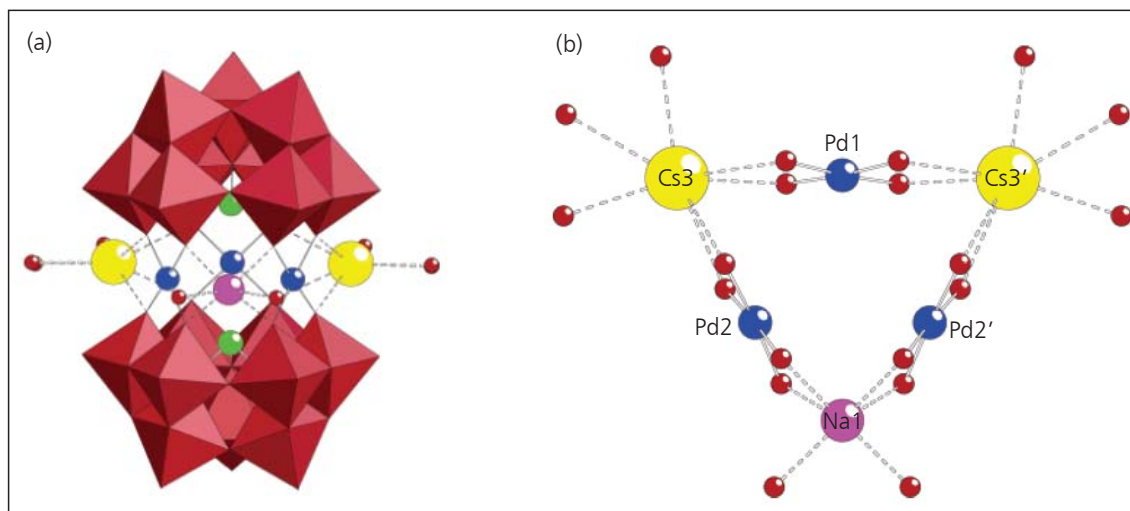


Fig. 1. (a) Combined polyhedral/ball-and-stick representation of $[\text{Cs}_2\text{Na}(\text{H}_2\text{O})_{10}\text{Pd}_3(\alpha\text{-Sb}^{\text{III}}\text{W}_9\text{O}_{33})_2]^{9-}$. The WO_6 octahedra are shown in red and the balls represent palladium (blue), antimony (green), caesium (yellow), sodium (purple) and water molecules (red); (b) ball-and-stick representation of the central belt of $[\text{Cs}_2\text{Na}(\text{H}_2\text{O})_{10}\text{Pd}_3(\alpha\text{-Sb}^{\text{III}}\text{W}_9\text{O}_{33})_2]^{9-}$ (Reprinted with permission from L.-H. Bi, M. Reicke, U. Kortz, B. Keita, L. Nadjo and R. J. Clark, *Inorg. Chem.*, 2004, **43**, (13), 3915. Copyright 2004 American Chemical Society)

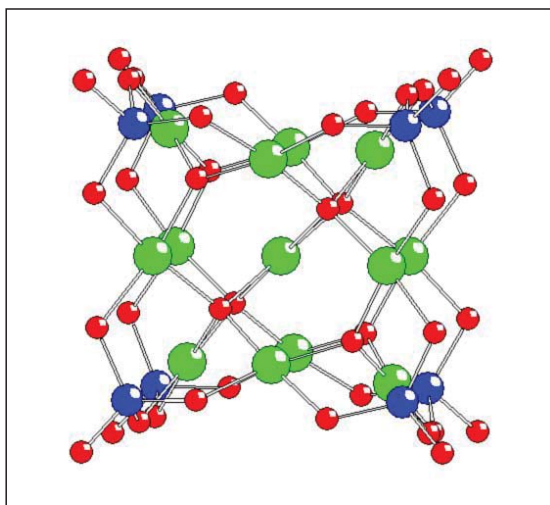


Fig. 2. Ball-and-stick representation of $[\text{Pd}_{13}\text{As}^{\text{V}}_8\text{O}_{34}(\text{OH})_6]^{8-}$. The colour code of the balls is as follows: Pd (green), As (blue), O (red). Hydrogens not shown (Copyright 2013 Professor Ulrich Kortz)

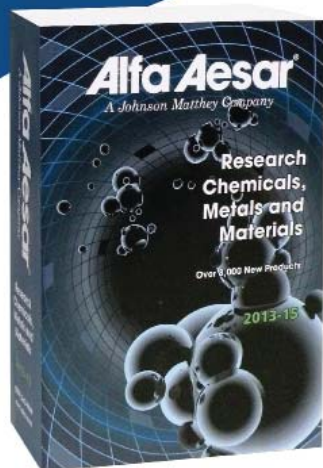
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