

Abstract

Calcium ions react with phosphorus acid forming two types of salts: $\text{Ca}(\text{HPO}_3)\cdot\text{H}_2\text{O}$ and $\text{Ca}(\text{H}_2\text{PO}_3)_2\cdot\text{H}_2\text{O}$. Both compounds exhibit two-dimensional inorganic networks of linked calcium and phosphorus polyhedra, while each calcium ion is coordinated by the 7 oxygen atoms. The crystal structure of $\text{Sr}(\text{HPO}_3)\cdot\text{H}_2\text{O}$ has been determined from single-crystal X-ray diffraction data. It is isostructure with the corresponding calcium salt, however, the strontium ion is 7+1 coordinated showing a tendency to form high coordination number than the calcium ion. Calcium and strontium phenylphosphonates were also prepared and structurally characterized. They are isostructure and indicate layered frameworks, in which two-dimensional inorganic network are separated from each other by the phenyl groups. Thermal properties on these two metal phosphonates were studied by means of thermodiffraction, TG and DTA analyses. They are stable up to about 300 °C, while decompose by heating up forming condensed phosphates. The structure-property relationships between metal phosphites and phosphonates have been discussed in respect to their potential application for surface treatment of different objects such as stones and metals. Organic phosphorus acids are capable of forming extensive hydrogen bonding networks. Phosphonic acids, such as phenylphosphonic acid and methylphosphonic acid, can act as the hydrogen bond donors or acceptors providing the possibility to use as building blocks for crystal engineering of organic solids. Organic ammonium salts of phenylphosphonic, methylphosphonic and butanebisphosphonic acids were prepared and in addition structurally characterized using single-crystal X-ray diffraction technique. They generally show layered or pillared-layered structures that are related to their inorganic counterparts, metal phosphonates and bisphosphonates. Polymorphism, supramolecular isomorphism and isomerism were found with of these compounds. Graph-set theory was used to interpret the hydrogen bonding patters and their similarities. A nanoporous material based on bisphosphonate was also prepared. A new class of organosilicon-phosphonate compounds was designed and prepared to be used for surface treatments and stone conservation.

Keywords

Alkaline-earth metals, crystal structure, hydrogen bonding, metal phosphites, metal phosphonates, organic ammonium salts, polymorphism, surpamolecular assemblies, and thermal properties

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ISBN 91-628-5006-7