[P1.238]

Proton conductivity of multifunctional metal phosphonate frameworks

A. Cabeza*[1], M. Bazaga-García[1], R.M.P. Colodrero[1], M. Papadaki[2], P. Olivera-Pastor[1], E.R. Losilla[1], L. León-Reina[1], L. Moreno-Real[1], M.A.G. Aranda[1,3], K. Demadis[2]

[1]University of Malaga, Spain, [2]University of Crete, Greece, [3]CELLS-ALBA Synchrotron, Spain

Metal phosphonates exhibit attractive characteristics for proton conductivity, such as tunable functionality, chemical and thermal stability and the existence of H-bond networks with acidic protons within their structure.[1]

In the present work, we examine the relationship between crystal structure and proton conductivity for several metal (mono-, di- and tri-valent) phosphonates containing rigid: (5-(dihydroxyphosphoryl)isophthalic acid, PiPhtA and 2-hydroxyphosphonoacetic acid, HPAA) or flexible: (hexa- or octamethylenediamine-N,N,N′,N′-*tetrakis*(methylenephosphonic acid, H_8HDTMP or H_8ODTMP) multifunctional ligands. The crystalline hybrid derivatives prepared show a great structural diversity, from 1D to 3D open-frameworks possessing hydrogen-bonded water molecules and phosphonic and carboxylic acid groups. The rigid 3D framework of Ca-PiPhtA, that exhibits a proton conductivity of $5.7 \cdot 10^{-4}$ S/cm as synthesized, transforms into a layered compound upon exposure to ammonia vapors[2] with increased proton conductivity ($6.6 \cdot 10^{-3}$ S/cm). The flexible frameworks of magnesium or lanthanide phosphonates, with 1D channels, present conductivities higher than 10^{-3} S/cm. Their activation energies fall in the range corresponding to a Grotthuss mechanism.[3,4] For M(I)-HPAA solids conductivities up to $5.6 \cdot 10^{-3}$ S/cm were measured.

References

1. P. Ramaswamy, N.E. Wong, G.K.H. Shimizu, *Chem. Soc. Rev.* 43 (2014) 5913.

2. M. Bazaga-García, R.M.P. Colodrero, M. Papadaki, P. Garczarek, J. Zoń, P. Olivera-Pastor, E.R. Losilla, L. León-Reina, M.A.G. Aranda, D. Choquesillo-Lazarte, K.D. Demadis, A. Cabeza, *J. Amer. Chem. Soc.* 136 (2014) 5731.

3. R.M.P. Colodrero, P. Olivera-Pastor, E.R. Losilla, D. Hernández-Alonso, M.A.G. Aranda, L. Leon-Reina, J. Rius, K.D. Demadis, B. Moreau, D. Villemin, M. Palomino, F. Rey, A. Cabeza, *Inorg. Chem.* 51 (2012) 7689.

4. R.M.P. Colodrero, P. Olivera-Pastor, E.R. Losilla, M.A.G. Aranda, L. Leon-Reina, M. Papadaki, A.C. McKinlay, R.E. Morris, K.D. Demadis, A. Cabeza, *Dalton Trans.* 41 (2012) 4045.

Keywords: metal phosphonate, proton conductivity, fuel cells, functional materials