

New Multifunctional Lanthanide and Zr(IV) Phosphonates Derived from the 5-(dihydroxyphosphoryl) Isophthalate Ligand as Proton Conductors

I.R. Salcedo,^a R.M.P. Colodrero,^b P. Olivera-Pastor,^a E.R. Losilla,^a J. Zon,^c J. Zaręba,^c F. Costantino,^d A. Cabeza^a and M. Bazaga-García,^a

^a Departamento de Química Inorgánica, Universidad de Málaga, Campus Teatinos s/n, Málaga 29071, Spain.

^b Faculty of Science & Engineering, University of Wolverhampton, Wulfruna Street, Wolverhampton WV1 1LY, UK.

^c Faculty of Mechanical and Power Engineering, Wrocław University of Technology, 27 Wybrzeże Wyspiańskiego, 50-370 Wrocław, Poland.

^d Dipartimento di Chimica, Biologia e Biotecnologie, Università di Perugia, Via Elce di Sotto, 8, 06123 Perugia, Italy.

m.bazaga@uma.es

Keywords: Coordination polymers • proton conductivity • functional materials • metal phosphonate.

Metal phosphonates are essentially acidic solids featured by groups such as P-OH, -COOH, etc. Moreover, the presence of coordination and lattice water molecules favors the formation of H-bond networks, which make these compounds appropriate as proton conductors, attractive for proton exchange membranes (PEMs) of fuel Cells.¹

We report here, general characteristics of metal phosphonate derivatives composed of the polyfunctional 5-(dihydroxyphosphoryl) isophthalate ligand² and lanthanides or zirconium ions. In the case of the lanthanide derivatives, crystalline compounds were synthesized under hydrothermal conditions. Preliminary results suggest that at least three isostructural series of compounds are formed. One of them, with La³⁺ derivative as prototype,

is characterized by an orthorhombic unit cell ($a = 12.7745(6) \text{ \AA}$, $b = 11.8921(4) \text{ \AA}$, $c = 7.2193(5) \text{ \AA}$). Pr³⁺, Eu³⁺ and Gd³⁺ compounds, displays a monoclinic unit cell likewise the Yb³⁺ solid, the latter exhibiting different crystallographic parameters. Zr(IV) = compound, with formula $\text{Zr}[(\text{HO}_3\text{P}-\text{C}_6\text{H}_3-(\text{COO})_2\text{H})_2] \cdot 8\text{H}_2\text{O}$; was obtained at 80 °C in the presence of HF as mineralizing agent. This solid crystallizes in an orthorhombic unit cell ($a = 21.9306 \text{ \AA}$, $b = 16.6169 \text{ \AA}$, $c = 3.6462 \text{ \AA}$). All these compounds contain in their frameworks water molecules that contribute to the formation of H-bond networks, making them prone as proton conductor candidates. Structural and proton conductivity are underway.

References

- [1] Cabeza, A.; Olivera-Pastor, P.; Colodrero, R. M. P. *Tailored Organic-Inorganic Materials*, Brunet, E., Colón, J.L., Clearfield, A., Eds.; John Wiley & Sons, Inc. 2015; Ch. 4, 137–191.
- [2] Bazaga-García, M.; Colodrero, R.M.P.; Papadaki, M.; Garczarek, P.; Zoń, J.; Olivera-Pastor, P.; Losilla, E.R.; León-Reina, L.; Aranda, M.A.G.; Choquesillo-Lazarte, D.; Demadis, K.D.; Cabeza, A. *J. Am. Chem. Soc.* **2014**, *136*, 5731–5739.