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Boron salts: anions that can help to reduce CO_2 emissions

One of the 17 Sustainable Development Goals (SDGs) to be achieved by 2030 is to ensure a healthy life of the population. To do so, improving air quality is one of the great challenges to be met. In this article, Francesc Teixidor and Clara Viñas, from the Barcelona Institute of Materials Science (ICMAB-CSIC), present their study in which they try to improve one of the components present in supercapacitors, fuel cells and batteries, that is, the polymeric electrolytic membrane. The results show that the application of boron salts provides very interesting physicochemical properties.

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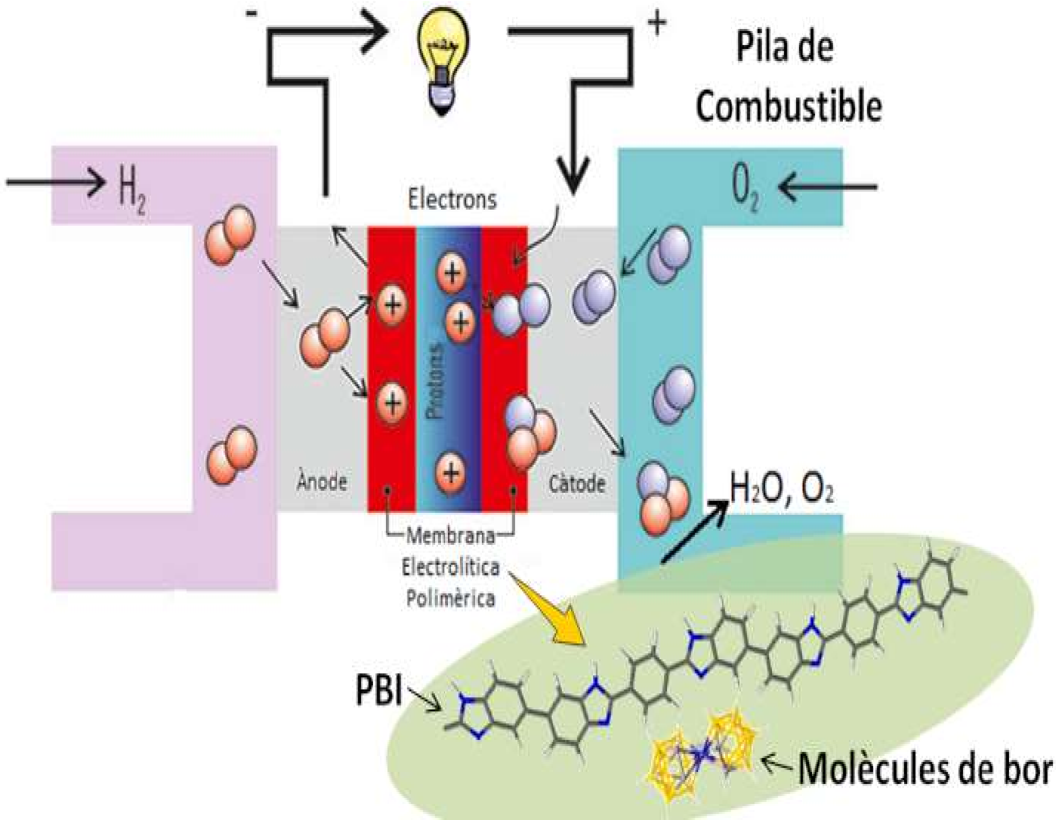
Fuel cells provide a sustainable and highly efficient alternative to oil based technologies that are responsible for global CO_2 emissions. For this reason, researchers from the Institute of Materials Science of Barcelona (ICMAB-CSIC) and from the Universidad Politecnica de Valencia (UPV) have worked on the development of a novel part of the fuel cells, the polymer electrolyte membranes that allow the transport of protons from the anode to the cathode.

The novelty of this work is the preparation of hybrid organic-inorganic composite polymer electrolyte membranes. The inorganic part is the icosahedron ionic salt of the electroactive boron complex $[Co(C_2B_9H_{11})_2]^-$ that are stable thermally and chemically. And the organic part is the polymer polybenzimidazole (PBI) that can be used at high temperatures and is widely used as a fireproof material as in the clothing of firefighters.

Previous studies of ionic conductivity of the boron salts used in this work show that boron molecules have good ionic conductivity to be used in polymer electrolyte membranes. The conductivity of these molecules depends on the cation, following the order of most to least conductive salts of $[Co(C_2B_9H_{11})_2]^-$ with the cations H^+>Na^+>Li^+.

Figure: polymeric electrolytic membrane of the fuel cell



Therefore, the studies of the hybrid PBI polymer doped with the salts of the boron anion have been made and compared with the undoped polymer that was taken as a reference. The experiments carried out in this work were to see how the dielectric and conductivity properties varies in the temperature range from 20 to 160°C, with the hydrated and dry samples, in addition to their characterization.

The results obtained show that PBI membranes doped with $[Co(C_2B_9H_{11})_2]^-$ have a high thermal stability (higher than pure PBI membrane from 650°C), excellent physicochemical properties in terms of hydration of the samples, and high ionic conductivity (PBI doped with the boron molecules have higher ionic conductivity than pure PBI from 150°C by two orders of magnitude).

Due to the good results obtained, it can be concluded that the development of novel polymer electrolyte membranes of PBI doped with the alkaline salts of the anion $[Co(C_2B_9H_{11})_2]^-$ have interesting transport properties as solid low-cost and durable electrolytes, exhibiting high performance applications in the fields of rechargeable metal ion batteries, supercapacitors and fuel cells.

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