

Development of proton exchange membranes using green solvents

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The increasing interest in fuel cell vehicle technology for sustainable mobility is driving a growing research effort for the development of efficient and durable components for polymer electrolyte membrane fuel cells (PEMFCs). PEMFCs are able to cleanly convert the chemical energy of hydrogen to electrical energy, producing water as the only by-product by reaction with oxygen. A proton exchange membrane (PEM) like Nafion¹ plays a key role as the core of the PEMFC. However, it is frequently overlooked that the methods used to produce PEMFC's components, including the PEM, is often quite far to be green. Most of the solvents used in industrially relevant membranes productions are hazardous to human health and to the environment and are currently mentioned as substances of very high concern (SVHC) in different lists guides, such as REACH². Therefore, there is a clear need to develop new production protocols where harmful solvents are replaced by not toxic substances³, overcoming in the same time the still existing technical limitation of the PEM's in terms of conductivity, barrier properties and durability. The main objective of this work is the design and development of sustainable protocols for the production of high performing PEM using non-toxic solvents and scalable preparation methods. Several bio solvents are under evaluated for the preparation of Nafion based membrane, also in the form mixed matrix membranes using nanostructured functional additives. Preliminary characterization of the membranes produced highlighted a relevant potential in terms of stability and electrochemical properties.

¹ Chem. Rev. 2004, 104, 10, 4535–4586

² Green Chem. 2016, 18, 288-296

³ Green Chem., 2014, 16, 4034–4059