Fabrication of proton exchange membranes using melt processing technologies

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Fabrication of proton exchange membranes using melt processing technologies.

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This presentation reports new routes to prepare functional polymers for PEMFC applications developped in our group. Several melt-processing technologies, such as twin-screw extrusion, melt blowing, calendering and compression moulding were used to prepare advanced polymer blends and nanocomposites based on fluoropolymers and hydrocarbon elastomers. The properties of these polymer blends are to a large level determined by the processing history and the interfacial properties. Our work has shown that materials developed exhibit a valuable combination of mechanical, chemical and electrochemical properties while being melt processed. The use of melt processable ionomers is also expected to provide a significant cost-reduction compared to conventional PEM fabrication technologies and will ease the scale-up toward mass production.
Blend membranes preparation and interface modification are addressed to obtain optimized semi-fluorinated and hydrocarbon composite membranes. Semi-fluorinated electrolyte materials recently developed at IMI showed a conductivity similar or higher than commercial PFSA-based PEM. These electrolytes show a room temperature conductivity of 8.10^{-2} S/cm when fully humidified, with a mechanical resistance up to 20 MPa for an elongation at break of 200%. The membranes maintained their mechanical strength after an outstanding 6000 hydration/dehydration cycles. The conductivity and fuel cell performance is expected to be enhanced, particularly at high temperature and low RH by the incorporation of the fillers based on HPA/clays complexes and heteocycles/silica nanoparticles being developed presently.