1. Publishable summary

Summary description of project context and objectives Perfluorosulfonic acid ionomers (PFSA) are the polymers of choice for PEMFC membranes as they have demonstrated excellent properties in terms of chemical resistance in the fuel cell environment. Low equivalent weight variants of these ionomers are required to reach the membrane conductivity and MEA performance targets for stationary operation and enable stationary PEMFC systems to achieve superior overall system yield to competitive technologies. In stationary applications, where the situation of deep MEA dehydration and frequent open circuit voltage events can be reasonably avoided, the most relevant failure mode in extended life time operation is associated with membrane mechanical failure. The use of a pre-formed inert support for mechanical stabilisation within the membrane has the drawback of reducing membrane specific conductivity, and this frequently necessitates a reduction in membrane thickness to very low values. The primary objective of MAESTRO was to improve the mechanical properties of low equivalent weight state of the art perfluorosulfonic acid membranes using chemical and thermal ionomer processing and fibre network and filler reinforcement methodologies, while maintaining high proton conductivity. The baseline product for further development was the short side chain perfluorionomer that already showed the best combination between ionic conductivity and mechanical stability. MAESTRO further intended to characterise stabilised membranes for their ex situ properties and to integrate selected candidate membrane materials into MEAs and validate them by evaluating single cell performance and durability under accelerated stress testing conditions designed to enhance chemical and/or mechanical degradation. The objective of the second phase of the project was to associate the most prospective individual approaches, and then down-select most promising candidate membranes on the basis of the membrane proton conductivity and tensile properties, and MEA fuel cell performance and durability on OCV hold and in wet-dry cycling. The final aim of the project was to submit these candidate membranes, after MEA preparation, to accelerated durability testing over 1000 hour periods comprising repeated stop-start events and voltage cycling, in conditions simulating those encountered in a micro-CHP application, with a target durability indicator of achieving voltage loss below 10 percent of that at beginning of life.