ISIS@MACH ITALIA

Science and Technology Facilities Council
ISIS Neutron and Muon Source

Experiment Proposal

Experiment number GP2023031

Principal investigator (*) Dr Claudio Resta, Enapter SRL, ITALY
Co-investigator Dr Antonio Filpi, Enapter srl, ITALY
Co-investigator Dr Gabriele Agonigi, enapter s.r.l., ITALY
Co-investigator Miss Federica Trivarelli, Enapter, ITALY
Co-investigator
Co-investigator
Co-investigator
Co-investigator
Co-investigator

Experiment title Confocal Raman Microscopy on Membrane-electrode assembly components

MRF Instrument	**Raman Confocal Microscope**	**Days requested:** 1
Access Route	Direct Access	**Previous GP Number:** No
Science Areas	Chemistry, Energy, Environment, Materials	**DOI:** -
Sponsored Grant	None	**Sponsor:** -
Grant Title	-	**Grant Number:** -
Start Date	-	**Finish Date:** -
Similar Submission?	-	
Industrial Links	-	

Non-Technical Abstract Enapter produces scalable and modular AEM electrolysers, a relatively relatively new techno -logy, to produce hydrogen and oxygen from water splitting electrochemical reaction. Key components are MEA (Membrane Electrode Assemblies) and PTL (Porous Transport Layer). AEM technology combines advantages of both classical alkaline and PEM water electrolysis, to produce high purity hydrogen at relatively high pressure and high current density without using expensive or scarce materials (e.g. Tit, Ir, Pl). Our research programmes would relevantly benefit by using powerful characterization techniques. Potentialities of those techniques have only been barely explored in companies' framework and may constitute a breakthrough on the analysis of the MEA components in AEM systems.

Publications -

ISIS neutron and muon source

IM@IT E-platform: No

Instruments	**Days Requested:**
Access Route	**Previous RB Number:**
Science Areas	**DOI:**
Sponsored Grant	**Sponsor:**
Grant Title	**Grant Number:**
Start Date	**Finish Date:**
Similar Submission?	
Industrial Links	

Sample record sheet

Principal contact Dr Claudio Resta, Enapter SRL, ITALY
MRF Instrument **Raman Confocal Microscope** **Days Requested:** 1
Special requirements:

SAMPLE

Material	Polymers and metals	-	-
Formula	CHNOCu	-	-
Forms	Solid		
Volume	1 cc		
Weight	100 mg		
Container or substrate	None	-	-
Storage Requirements	-	-	-

SAMPLE ENVIROMENT

Temperature Range	Room Temperature - K	-	-
Pressure Range	Room Pressure - mbar	-	-
Magnetic field range	No magnetic field - T	-	-
Standard equipment	None	-	-
Special equipment	none	-	-

SAFETY

Prep lab needed	Yes	-	-
Sample Prep Hazards	no	-	-
Special equip. reqs	none	-	-
Sensitivity to air	No	-	-
Sensitivity to vapour	No	-	-
Experiment Hazards	no	-	-
Equipment Hazards	-	-	-
Biological hazards	none	-	-
Radioactive Hazards	no	-	-
Additional Hazards	-	-	-
Additional Details	-	-	-
Sample will be	Disposed of by instrument scientist	-	-

Science Case f

Confocal Raman Microscopy on Membrane-electrode assembly components

1. Background and Context

Enapter produces scalable and modular AEM electrolysers to produce hydrogen and oxygen from water splitting electrochemical reaction. Key components to allow efficient and durable performances are MEA (Membrane Electrode Assemblies) and PTL (Porous Transport Layer). AEM technology combines advantages of both classical alkaline and PEM water electrolysis, allowing to produce high purity hydrogen at relatively high pressure and high current density without using expensive or scarce materials (e.g. Titanium, Iridium, Platinum). Being the AEM technology relatively new, every single constituent of the final product needs to be extensively characterized to provide a deeper knowledge and speed up technological improvements.(e.g. connection between morphology and physical-chemical properties). Due to the novelty of the technology, very few advanced characterization techniques are routinely used in the field. Our research programmes would relevantly benefit by using powerful characterization techniques which Enapter doesn't own and are not readily accessible. Potentialities of those techniques have only been barely explored in companies' framework and may constitute a breakthrough on the analysis of the MEA components in AEM systems. Our main financial support comes from the holder Enapter AG, additionally Enapter earned a grant from PNRR programme from italian government and it is involved in an Horizon 2020 project ("CHANNEL").

2. Proposed experiment

Raman spectroscopy on MEA components will be important to understand the morphological and chemical organisation and composition of the different materials they are composed of. In particular,Raman spectroscopy combined with confocal microscopy will highlight the distribution of organic and inorganic portions on the surface and through the cross section. Being sensible to different organic moieties and allowing for the analysis of selected regions of the sample, this technique will be important to understand if chemical modification occurred on the different materials during its manufacturing or if the different organic components composing the MEA have preferential distributions.
The experiments will be performed aiming at the simultaneous characterisation of the morphology and the composition of the surface. The final results will be the acquisition of maps highlighting the differences in terms of composition and, more specifically, the presence of specific functional groups on the surface.

3. Summary of previous experimental proposals or characterisation

The MEA components have been extensively characterised by Enpater srl in terms of their performances. This investigation would allow to cross-correlate performances with morphological/compositional results and extract general guidelines for the development of efficient MEA components.

4. Justification of experimental proposals request

The Raman confocal microscopy is a unique instrument when aiming at the characterisation of morphological and compositional properties of polymeric and composite surfaces. In our experiment, we target the acquisition of compositional maps of the surface of MEA components. Given the number of samples (eight) and the time typically required to acquire maps with accurate resolution, following the suggestions by the ISIS@MACH Italia team we request two days of use of the microscope.