





Improved Durability and Cost-effective Components for New Generation Solid Polymer Electrolyte Direct Methanol Fuel Cells

Collaborative Project - FCH JU GRANT AGREEMENT N° 278054
SP1-JTI-FCH.2010.4.4 Components with advanced durability for Direct Methanol Fuel Cells

Start date: 01.12.2011 – Duration: 36 months

Project Coordinator: Antonino Salvatore Aricò – CNR-ITAE

DELIVERABLE REPORT

DELIVER	ABLE 7.3 – SURVEY OF DISSEM	MINATION AND OUTREACH ACTIVITIES		
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PU	Public		Х	
PP	Restricted to other programme participants (including the Commission Services)			
RE	Restricted to a group specified by the consortium (including the Commission Services)			
СО	Confidential, only for members of the consortium (including the Commission Services)			
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R	Report	Х		
Р	Prototype			
D	Demonstrator			
0	Other			

Keywords	Dissemination Outreach		
Abstract	The main objective of the survey of the dissemination and outreach activities is to report all the activities regarding the dissemination plan. This aimed to guarantee proper diffusion of knowledge and project results according to an agreed strategy aimed to secure maximum impact with respect to the Intellectual Property Rights. This document describes all the dissemination & outreach activities arising from the DURAMET project, during all the project duration. The following dissemination activities are described: — Research publications in peer-reviewed journals, — Meetings, conferences, — Website, — Outreach activities — Brochure — International workshop In total 14 publications have been produced so far, in peer-reviewed scientific journals and 32 presentations (oral or posters) given at international conferences. A complete list of journal publications, oral presentation, poster presentations and other is given.		

Version	Date	Changed by	Comments			
0.1	28-11-2014	Nathalie CROS				

D.7.3 - SURVEY OF DISSEMINATION AND OUTREACH ACTIVITIES

I. CONTENT OF DELIVERABLE

The main objective of the survey of the dissemination and outreach activities is to report all those activities regarding the dissemination plan. This aimed to guarantee proper diffusion of knowledge and project results according to an agreed strategy aimed to secure maximum impact with respect to the Intellectual Property Rights.

This document describes all the dissemination & outreach activities arising from the DURAMET project, during all the project duration.

The following dissemination activities are described:

- Research publications in peer-reviewed journals,
- Meetings, conferences,
- Website,
- Outreach activities
- Brochure
- Organisation of an International workshop

In total 15 publications have been produced so far, in peer-reviewed scientific journals and 33 presentations (oral or posters) given at international conferences.

A complete list of journal publications, oral presentation, poster presentations and other is given.

II. INTELLECTUAL PROPERTY RIGHTS (IPR)

Dissemination of the results generated by the DURAMET project shall receive the agreement of all the partners to protect the intellectual property rights, confidentiality and the legitimate interests according to the Grant Agreement article II.30.

To fulfil those requirements, a specific DURAMET dissemination protocol has been edited at month 3, and validated by the steering committee. This protocol has been and will continue to be used each time a partner wants to disseminate results obtained within the DURAMET context.

This protocol is provided in annex 1.

III. DISSEMINATION PLAN

1. INTENDED AUDIENCE & OBJECTIVES

The dissemination plan has various objectives depending on the type of audience, as detailed below:

- Scientific & Industrial communities: promote the diffusion of scientific results and DURAMET consortium activities
- General public: fulfil project communication and dissemination needs in the direction of the scientific community and the public

• Non-specialist scientists (students): to increase knowledge of advanced fuel cell technologies especially those dealing with portable and APU applications.

2. DISSEMINATION CHANNELS

2.1. DEDICATED PROJECT WEBSITE

The dedicated project website (figure 1) is one of the main dissemination channels towards the scientific community and the public.

A first version of a dedicated website was released in April 2011 (month 3 from the project start) available at http://www.duramet.eu. This version, after being validated by all the partners, has led to the current version of the DURAMET website fully operational since 18th March 2011.

Note that the project website also includes a link to a "Members Area", i.e. an area to which access is restricted to authorised users.

The public section features:

- General description of the project and its objectives
- Information about the consortium and links to partners' websites
- Public documents, such as public deliverables, publications (open-access provided), project posters
- Contact information

The web site will be kept open and updated with new publications and other project output until 2 years after the project end date, when the situation will be reassessed with the DURAMET partners.



Figure 1: DURAMET website home page

2.2. Participation in international conferences

The consortium has attended prominent international conferences, workshops and symposia. All presentations have followed the dissemination protocol to protect IPR (see annex 1).

List of conference presentations

- EMRS 2012 SPRING MEETING May 14-18, 2012 Symposium F on Solid Proton Conductors, Palais des Congrès, Strasbourg, France
 - Invited oral presentation: Cost-effective Solid Polymer Electrolytes with Reduced Cross-over for Direct Methanol Fuel Cells, A. S. Aricò, F. Lufrano, V. Baglio, V. Antonucci, CNR-ITAE, Italy, F61, Monday May 15, 2012; 10:30-11:00
 - Poster presentation: Improved Durability and Cost-effective Components for New Generation Solid
 Polymer DURAMET Project, A. S. Aricò, F49, Monday May 14, 2012; 16:00
- 2. GEIERA2012, 17 22 June 2012, Santa Marina Salina, Messina, Italy
 - Poster presentation: Composite Anode Catalyst for Direct Methanol Fuel Cells Operating at Low Temperatures, V. Baglio, S. C. Zlignani, S. Sliracusano, A. Stassi, A. S. Aricò, CNR-ITAE, Italy, ENE-P-04, Tuesday June 19, 2012
 - Poster presentation: Performance of DMFCs in subfreezing conditions, A.H.A. Monteverde Videla, G.G.
 Lenzi, C. Francia, V. Specchia, P. Spinelli, S. Specchia, POLITO, Italy
- 3. ECS fall Meeting, PRiME 2012, 7-12 October 2012, Honolulu, Hawai
 - Oral presentation: Preparation and characterization of Ti based supports for electrochemical energy conversion devices, S. Siracusano, V. Baglio, E. Modica, A. Stassi, A. S. Aricò, CNR-ITAE, Messina, Italy
- 4. 2012 Fuel Cell Seminar & Energy Exposition, 5-8 November 2012, Uncasville, Connecticut USA
 - Poster presentation: Ti oxide based catalyst supports for low temperature fuel cells, CNR-ITAE, Messina, Italy
- 5. FCH-JU review days, 28-29 November 2012, Brussels, Belgium
 - o Oral presentation: DURAMET project, A. S. Aricò, CNR-ITAE, Messina, Italy
- 6. 13th ISE Topical Meeting, 7-10 April, 2013, Pretoria, South Africa
 - Poster presentation: Investigation of a Composite Anode Catalyst in Direct Methanol Fuel Cells, V. Baglio,
 S. C. Zignani, S. Siracusano, A. STtassi, A. S. Aricò, CNR-ITAE, Messina, Italy
 - o **Poster presentation:** Ti Oxide Based Catalyst Supports for Low Temperature Fuel Cell, S. Siracusano, V. Baglio, E. Modica, A. Stassi, A. S. Aricò CNR-ITAE, Messina, Italy
- 7. HYCELTEC 2013, June 26-28 2013, Estoril, Portugal
 - Oral presentation: Investigation of PtCo catalysts in direct methanol fuel cells, V. Baglio, A. Stassi, C. D'Urso, A.S. Aricò, CNR-ITAE

8. 4th European PEFC & H₂ Forum 2013, July 3-5 2013, Lucerne, Switzerland

o **Poster presentation:** Valve Metal Oxide Based Catalysts for the Oxygen Reduction Reaction in Acidic DMFCs, T. Mittermeier, P. Madkikar, X. Wang, H. A. Gasteiger, M. Piana, TUM

9. CSE 2013, 5-9 July 2013, Guangzhou, China

o Invited oral presentation: Improved durability and cost-effective components for new generation solid polymer electrolyte direct methanol fuel cells, Stefania Specchia, Antonino A. Aricò, Deborah Jones, Michael Schuster, Mauro F. Sgroi, Hubert Gasteiger, Jacob L. Bonde, Nathalie Cros, Georgios Tsotridis

10. GEI 2013, 22-27 September 2013, Pavia, Italy

o **Poster presentation**: Development of Durable and Cost-effective Cathode Electrocatalysts for Direct Methanol Fuel Cells, V. Baglio, C. D'Urso, D. Sebastián, A. Stassi, A. S. Aricò, CNR-ITAE

11. SFGP, 8-10 October 2013, Lyon, France

Poster presentation: Improved Durability and Cost-effective Components for New Generation Solid
 Polymer - DURAMET Project, S. Specchia, POLITO

12. ECS-fall-meeting, 27 October-1 November 2013, San Francisco

Oral presentation: Temperature Study on Zr-Oxides for the ORR in DMFCs, T. Mittermeier, P. Madkikar,
 X. Wang, M. Piana, H. A. Gasteiger, TUM

13. FCH-JU review days, 11-12 November 2013, Brussels, Belgium

o Oral and poster presentation: DURAMET project, A. S. Aricò, CNR-ITAE, Messina, Italy

14. Fuel Cells 2014 – Science and Technology conference that will be held in Amsterdam, the Netherlands from 3 - 4 April 2014.

Oral presentation: Pd-based electrocatalysts for direct methanol fuel cells, A. Stassi, V. Baglio, C. D'Urso,
 D. Sebastián, A. S. Aricò, CNR-ITAE

15. 225th ECS Meeting, Orlando FL (USA), May 11th-15th 2014

Oral presentation: Catalysts Based on Trimetallic Formulations for the Electro-Oxidation of Methanol, D.
 Sebastián, V. Baglio, C. D'Urso, A. Stassi, A.S. Aricò, CNR-ITAE

16. Symposium on "Fuel Cells: Materials and Technology Challenges" Special session FA-4 DURAMET, CIMTEC conference, Montecatini Terme (FI, Italy) CIMTEC 2014 - 6th Forum on new materials, 15-20 June 2014, Montecatini, Italy

- Poster presentation: Improved Durability and Cost-effective Components for New Generation Solid Polymer- DURAMET Project, A.S. Aricò, CNR-ITAE
- Oral presentation: Composite Anode Catalysts based on PtRu and Metal Oxides for DMFCs, D. Sebastián,
 V. Baglio, C. D'Urso, A. Stassi, A.S. Aricò, CNR-ITAE
- Oral presentation: Pd-based electrocatalysts as cost-effective cathodes for direct methanol fuel cells, V.
 Baglio, C. D'Urso, D. Sebastián, A. Stassi, A. S. Aricò, CNR-ITAE
- Oral presentation: Direct Methanol Fuel Cell Stack Design and Test in the framework of DURAMET Project,
 O. Barbera, A. Stassi, V. Baglio, D. Sebastian, A.S. Aricò, CNR ITAE,

- Oral presentation: Membranes for Direct Methanol Fuel Cells, Deborah Jones, CNRS
- Oral presentation: DMFC degradation and lifetime studies, Jacob L. Bonde, IRD
- Oral presentation: 3D Direct Methanol Fuel Cell (DMFC) validation model for analysing new materials and components, N. S. Vasile, A. H.A. Monteverde Videla, S. Specchia, POLITO
- Oral presentation: Synthesis and Characterization of ZrO₂ Nanoparticles from an Organometallic Precursor as ORR-Selective Catalysts for DMFCs, P. Madkikar, T. Mittermeier, C. Denk, X. Wang, M. Piana, A.H.A. Monteverde Videla, S. Specchia, H. A. Gasteiger, TUM
- Oral presentation: Impact of N/Zr atomic ratio on the oxygen reduction reaction activity of heat-treated carbon-supported Zr-oxyphthalocyanine,T. Mittermeier, C. Denk, X. Wang, H. Beyer, P. Madkikar, M. Piana, H. A. Gasteiger, TUM
- Poster presentation: Nobel-metal-free anode catalysts for direct methanol fuel cells X. Wang, P. Madkikar,
 T. Mittermeier, M. Piana, H.A. Gasteiger, TUM
- Poster presentation: Ab-initio simulation of beta-Ta2O5 as a catalyst for oxygen reduction reaction, M. F.
 Sgroi and V. Dellacà, CRF

17. EEST2014 congress, Shanghai, P.R. China

 Oral presentation: Varying the morphology of FeTMPPCI electrocatalysts by using different SiO₂ template promoting the Oxygen Reduction Reaction, A.H.A. Monteverde Videla, L. Osmieri, S. Specchia, POLITO

18. EHEC 2014, 12-14 March 2014, Seville, Spain

Oral presentation: Noble metal oxide and valve metal oxide promoters of Pt for methanol oxidation, V.
 Baglio, R.S. Amin, K.M. El-Khatib, S. Siracusano, A. Stassi, D. Sebastián, A.S. Aricò, CNR-ITAE

19. UECT 2014, 23-26 June, Ulm, Germany

 Poster presentation: 3D Multi-physics modelling and validation of a Direct Methanol Fuel Cell for analyzing internal phenomena and the influence of new materials in performance optimization, N. S. Vasile, Alessandro H.A. Monteverde Videla, V. Baglio, A. S. Aricò, S. Specchia, CNR-ITAE, POLITO

20. FCH-JU review days, 10-11 November 2014, Brussels, Belgium

o Poster presentation: DURAMET project, A. S. Aricò, CNR-ITAE, Messina, Italy

2.3. JOURNAL PUBLICATIONS

The Consortium has published, and will continue to submit for publication, a number of individual or joint publications to scientific journals. As for participation in international events, each publication has followed the DURAMET dissemination protocol.

 Hybrid ordered mesoporous carbons doped with tungsten trioxide as supports for Pt electrocatalysts for methanol oxidation reaction, J. Zeng, C. Francia, C. Gerbaldi, V. Baglio, S. Specchia, P. Spinelli, A. S. Aricò, POLITO, Torino, Italy and CNR-ITAE, Messina, Italy, Electrochimica Acta, Volume 94, 1 April 2013, Pages 80– 91.

- 2. Composite anode electrocatalyst for direct methanol fuel cells, V. Baglio, S. C. Zignani, S. Siracusano, A. Stassi, C. D'Urso, A. S. Aricò, *Electrocatalysis December 2013, Volume 4, Issue 4, pp 235-240, (http://www.doi.org/:DOI 10.1007/s12678-013-0139-0).*
- 3. Preparation and characterisation of Ti oxide based catalyst supports for low temperature fuel cells, S. Siracusano, A. Stassi, E. Modica, V. Baglio, A.S. Arico', International Journal of Hydrogen Energy Volume 38, Issue 26, 30 August 2013, Pages 11600–11608 (http://dx.doi.org/10.1016/j.ijhydene.2013.04.161).
- **4.** Performance analysis of polymer electrolyte membranes for direct methanol fuel cell, F. Lufrano, V. Baglio, P. Staiti, V. Antonucci, A.S. Aricò, *Journal of Power Sources Volume 243, 1 December 2013, Pages 519–534* (http://dx.doi.org/10.1016/j.jpowsour.2013.05.180)
- 5. Improved Pd electro-catalysis for oxygen reduction reaction in Direct Methanol Fuel Cell by reduced graphene oxide, R. Carrera-Cerritosa, V. Baglio, A. S. Aricò, J. Ledesma-García, M. F. Sgroi, D. Pullini, A. J. Pruna, D. Busquets Mataix, R. Fuentes-Ramírez, L. G. Arriaga, Applied Catalysis B: Environment Volume 144, January 2014, Pages 554–560, (http://dx.doi.org/10.1016/j.apcatb.2013.07.057)
- 6. AC Impedance Spectroscopy Investigation of Carbon Supported Pt3Co and Pt Cathode Catalysts in Direct Methanol Fuel Cell, F. Capitanio, S. Siracusano, A. Stassi, V. Baglio, A.S. Arico, A.C. Tavares, Int. Journal of Hydrogen Energy, Volume 39, Issue 15, 15 May 2014, Pages 8026–8033, DOI: 10.1016/j.ijhydene.2014.03.080
- 7. Composite anode electrode based on iridium oxide promoter for direct methanol fuel cells, V. Baglio, D. Sebastián, C. D'Urso, A. Stassi, R.S. Amin, K.M. El-Khatib, A.S. Aricò, Electrochemica *Acta, Volume 128, 10 May 2014, Pages 304–310*, DOI: 10.1016/j.electacta.2013.10.141
- 8. PtCo catalyst with modulated surface characteristics for the cathode of direct methanol fuel cells, V. Baglio, C. D'Urso, D. Sebastián, A. Stassi, A.S. Aricò, *Int. Journal of Hydrogen Energy, Volume 39, Issue 10, 26 March 2014, Pages 5399–5405*, DOI: 10.1016/j.ijhydene.2013.12.015
- 9. IrO2 as promoter of Pt-Ru for methanol electro-oxidation, V. Baglio, R.S. Amin, K.M. El-Khatib, S. Siracusano, C. D'Urso, and A.S. Aricò, Phys. Chem. Chem. Phys., 2014, 16, 10414-10418, DOI: 10.1039/C4CP00466C
- **10.** Metal oxide promoters for methanol electro-oxidation, R.S. Amin, K.M. El-Khatib, S. Siracusano, V. Baglio, A. Stassi, A.S. Aricò, *International Journal of Hydrogen Energy Volume 39, Issue 18, 15 June 2014, Pages 9782–9790, doi:10.1016/j.ijhydene.2014.04.100*
- 11. Synthesis of Pd3Co1@Pt/C core-shell catalysts for methanol tolerant cathodes of direct methanol fuel cells, A. S. Aricò, A. Stassi, C. D'Urso, D. Sebastián and V. Baglio, *Chemistry. 2014 Aug 18; 20(34):10679-84. DOI: 10.1002/chem.201402062.*
- 12. Activity of Co-N multi walled carbon nanotubes electrocatalysts for oxygen reduction reaction in acid conditions, Luigi Osmieri, Alessandro H. A. Monteverde Videla, Stefania Specchia submitted to Journal of Power Sources
- **13.** Facile synthesis of Zr and Ta-based catalysts for the oxygen reduction reaction, David Sebastián, Vincenzo Baglio, Shuhui Sun, Ana C. Tavares, Antonino S. Aricò submitted to Chinese Journal of Catalysis.
- **14.** Direct methanol fuel cell stack design and testing for application in portable and auxiliary power units, O. Barbera, A. Stassi, D. Sebastian, J.L. Bonde, G. Giacoppo, C. D'Urso, V. Baglio, A.S. Aricò, submitted to Applied Energy.

15. Valve Metal Oxide Based Catalysts for the Oxygen Reduction Reaction in Acidic DMFCs, Thomas Mittermeier^a, Pankaj Madkikar^a, Xiaodong Wang^a, Hubert A. Gasteiger^a, Michele Piana^a, a) Technische Universität München, Lehrstuhl Technische Elektrochemie, Lichtenbergstr. 4, D-85748 Garching b. München, *Proceedings of 4th European PEFC & H2 Forum 2013, ISBN 978-3-905592-17-7, submitted*

2.4. EDUCATION ACTIONS & OUTREACH ACTIVITIES

Six education actions and outreach activities towards non-specialist scientists (university students) have been undertaken by the consortium.

2.4.1. LIST OF EDUCATION & OUTREACH ACTIVITIES ACTIONS

- 1. November 5-10, 2012 China Jiliang University in Hangzhou (P.R. China) During a visit at the China Jiliang University in Hangzhou (P.R. China) on November 5-10, 2012, Stefania Specchia delivered a lecture for master students entitled "Advanced Research Activities @ POLITECNICO DI TORINO on Low-Temperature Fuel Cells" where the DURAMET project was presented.
- 2. October 2012 Politecnico di Torino, Torino, Italy Once a year, usually in October, for the 3rd level course in POLITO, (open to all PhD students), the POLITO team shortly presented on-going EU projects on hydrogen and fuel cells: "Hydrogen technologies and fuel cells". This course has 2 different teachers working in the DURAMET project: Stefania Specchia and Carlotta Francia, it represents a total of 25 hrs overall.
- 3. September 2013 University of Pavia, Italy: Dr. Antonino S. Aricò from CNR-ITAE, a taught a course of the school "Energetica e Sensori" addressed to PhD students from 18th to 21st September 2013 at the University of Pavia, Department of Chemistry. The topic of these lectures was on Fuel Cells and more specifically on Direct Methanol Fuel Cells and DURAMET FCH-JU Project, also including a laboratory session.
- **4. 7 November 2013 China Jiliang University**: Gre.En² Group activity on fuel cells and DURAMET project, lecture at the China Jiliang University (P.R. China), Stefania Specchia, POLITECNICO DI TORINO
- 5. 7 August 2014 Westfälische Hochschule: Gre.En² Group activity on fuel cells and DURAMET project, lecture at the Westfälische Hochschule (Germany), Stefania Specchia, POLITECNICO DI TORINO
- **6. 5 November 2014 Tongji University Shanghai**: Gre.En² Group activity on fuel cells and DURAMET project, lecture at the Tongji University Shanghai (P.R. China), A.H.A. Monteverde Videla, POLITECNICO DI TORINO

2.5. DURAMET WORKSHOP

A DURAMET workshop has been organised during the CIMTEC 2014 - 6th Forum on new materials (Materials Solutions for Sustainable Energy) within the symposium on "Fuel Cells: Materials and Technology Challenges (website link)" held in Montecatini (Toscany) on June 15-20 2014.

During the "FA-4 DURAMET Workshop on Direct Alcohol Fuel Cells (DAFCs)" 85 participants were registered and 20 presentations given

2.6. DURAMET BROCHURE

To focus more on dissemination towards academic and industrial specialists, a leaflet presenting DURAMET objectives, consortium and output has been prepared (figure 2). This brochure has been circulated among the partners for their feedback and then printed and made available for distribution during conferences, workshops ...

This brochure is also available for download from the DURAMET public web site: http://www.duramet.eu/brochure.html.



Figure 2: DURAMET brochure

3. DISSEMINATION MATERIAL

To ensure a visual identity to the DURAMET project various supports has been developed and was used each time the project was presented (conferences, workshops, meetings...)

- Logo (figure 3)
- Presentation template



Figure 3: DURAMET logo

ANNEX 1: DURAMET DISSEMINATION PROTOCOL

Authors: Antonino Salvatore Aricò (CNR-ITAE) & Nathalie Cros (PXO)

REVISIONS	EVISIONS					
Version:	Date:	Changed by:	Comments:			
0.10	05 January 2012	A. Aricò, CNR-ITAE N. Cros, PXO	First draft			

SCOPE

Dissemination of the foreground generated by DURAMET shall receive the agreement of the partners to protect the intellectual property rights, confidentiality and the legitimate interests according to the Article II.30 of the FCH JU-GA.

PROCEDURE TO REQUEST PERMISSION FOR PUBLICATION OF FOREGROUND

- 1) A partner wishing to publish foreground generated in the project shall, at least 30 days prior to the presentation or publication, provide the relevant WP leader with the:
 - Abstract of the proposed presentation (indicate conference name, date); or
 - Complete presentation material, in the case of a conference presentation that the partners have already agreed can be made; or
 - Manuscript of the proposed publication (indicate journal name); or
 - Other documents describing the foreground it is proposed to disseminate.
- 2) Partner or intranet administrator (PXO) shall upload the document(s) on the DURAMET intranet site in a dedicated folder ("Items for Dissemination") of the Knowledge base.
- 3) Partner or intranet administrator (PXO) shall send an email notification to the Coordinator and all partners indicating the date of document upload.
- 4) All partners have 15 days from date of posting in which to raise any objection to publication. Any objection shall be in writing to the lead contact for the proposed dissemination item, with cc to the Coordinator.
- 5) Any Party objecting to a publication shall show that its legitimate interests will suffer disproportionately great harm and shall include a precise request for necessary modifications.
- 6) Thereafter, the information is deemed publishable.

REMARKS

1) Acknowledgement to the FCH-JU:

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- 2) Publication Details: An electronic copy of published version shall be provided to the Coordinator within 2 months of publication, so it can be made available to the FCH-JU.
- 3) The abstract and publication reference shall be posted on the DURAMET website, and an electronic version of the complete publication shall be uploaded to the DURAMET Knowledge base in a dedicated folder "Disseminated Results".