

Verso una piattaforma italiana per l'idrogeno e le celle a combustibile

**2° WORKSHOP TOSCANO SULL'IDROGENO e TECNOLOGIE COLLEGATE
OPPORTUNITA' e FINANZIAMENTI**

Firenze, 25 Luglio 2014

REGIONE
TOSCANA



2° WORKSHOP TOSCANO SULL'IDROGENO e TECNOLOGIE COLLEGATE

Firenze 25 Luglio 2014

Progetti ed esperienze di successo

Istituto di Chimica dei Composti OrganoMetallici



National Research Council of Italy

Francesco Vizza





RESEARCH AREA SESTO FIORENTINO



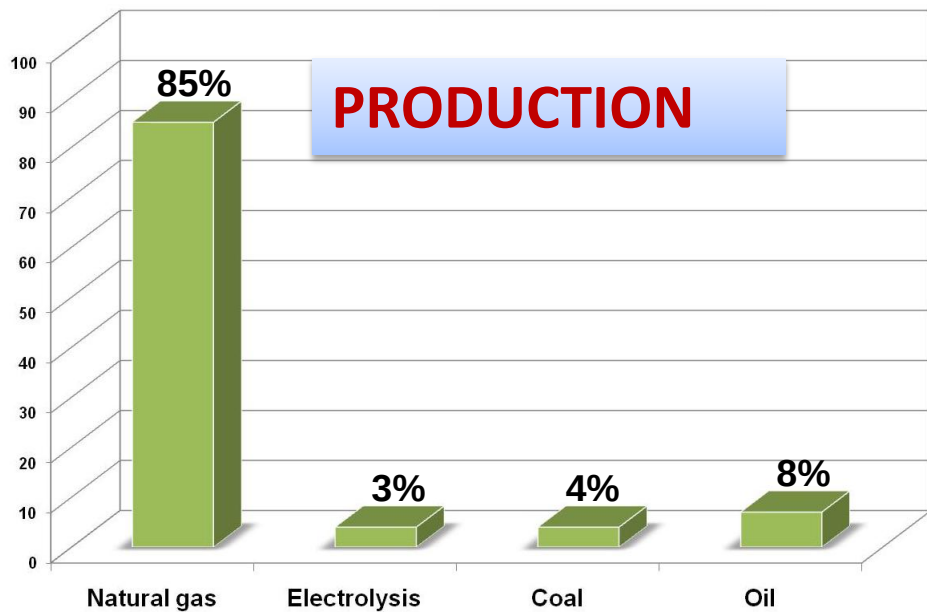
Institute of Chemistry of Organometallic Compounds SESTO FIORENTINO

N. 35 Researchers + 40 doctorate, PhD etc.

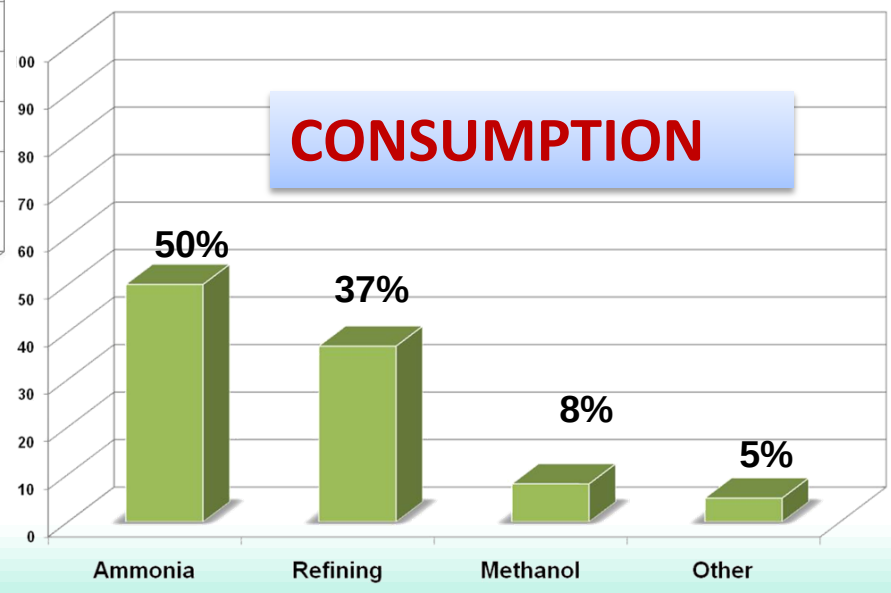
Energy e Sustainable Chemistry

H ₂ and FUEL CELLS	Researchers	9
	Other Staff	6

H₂: not only energy!



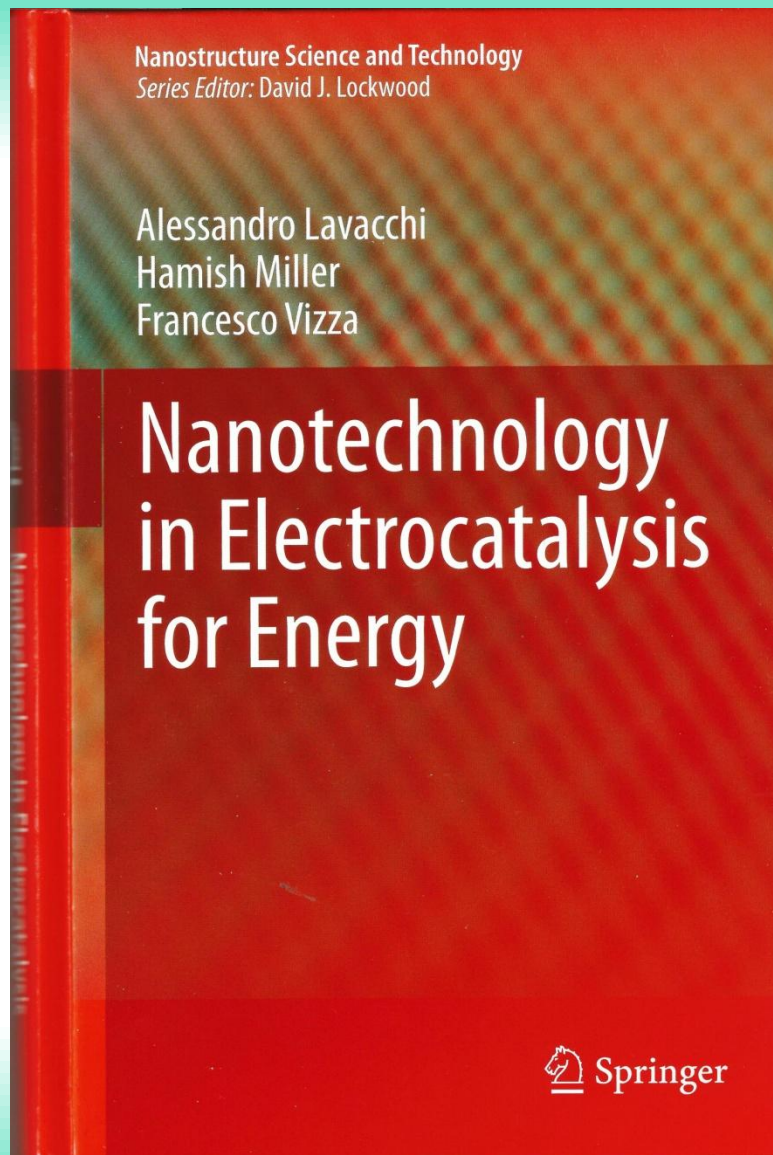
Worldwide production
~ 500 millions Nm³/y





ICCOM

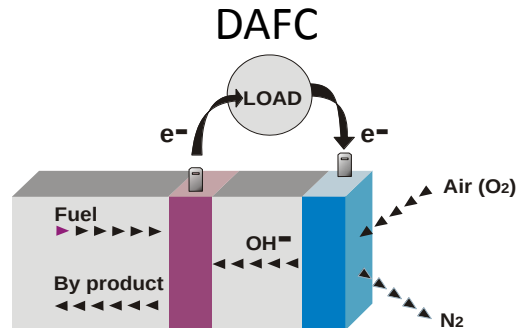
February 2014



Research activities

Fuel Cells

DAFCs and PEMFCs



H₂ generation

from formic acid

Dr. L. Gonsalvi

H₂ storage

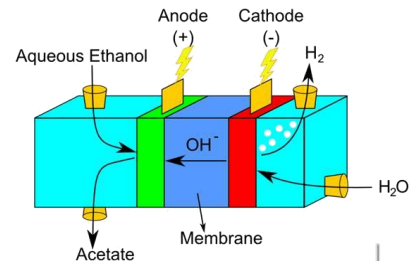
by amino-boranes

Dr. A. Rossin

Electrolysis

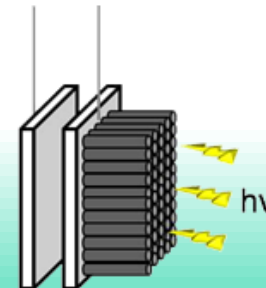
H₂ production from
renewable alcohols

PEM



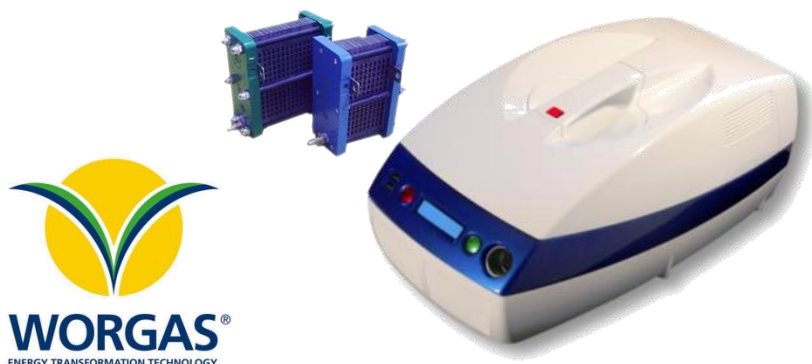
Photocatalysis

H₂ production from
renewable alcohols



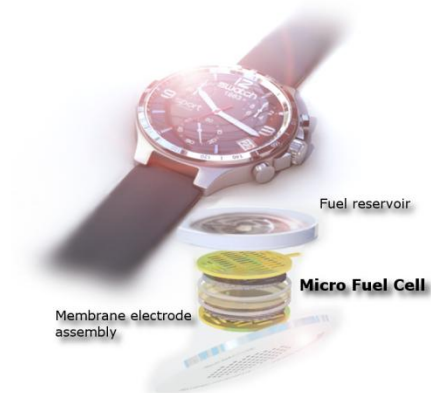
Power generators portable or transportable

PEMFC



Fuel:
H₂ from metals, borohydrides
(2 kWh)

Micro fuel cells 1 cm³



Fuel:
alcohols or formic
acid
(10-30 μ W)

Power generators portable or transportable



Emergency



Camping



Boats



Caravan



Remote housing

Portatili

Installabili

There is little doubt that a major issue hampering the commercial diffusion of PFCs in the power range from 100 to 250 W is the hydrogen source. Systems that make use of compressed hydrogen are not attractive for the need of carrying heavy and unsafe cylinders with limited autonomy (generally 1 or 2 normal cubic meters of hydrogen) and difficult recharging procedures.

Successful cases

Portable generator for electricity (up to about 100 W)



Generation of H₂ *on-demand* and its conversion into electricity by means of a PEMFC stack



4 liters of H₂O + 500 g NaBH₄
1kWh



Total weight	8 kg
Tank	4 liter
Max power	100 W
Nominal current	8 A

Portable Generator for electricity (up to 200 W)



On-demand generation of H₂ from metal powder and its conversion into electricity through a PEMFCs stack



Benefits

Clean energy and ZERO emission technology

Portability and high autonomy

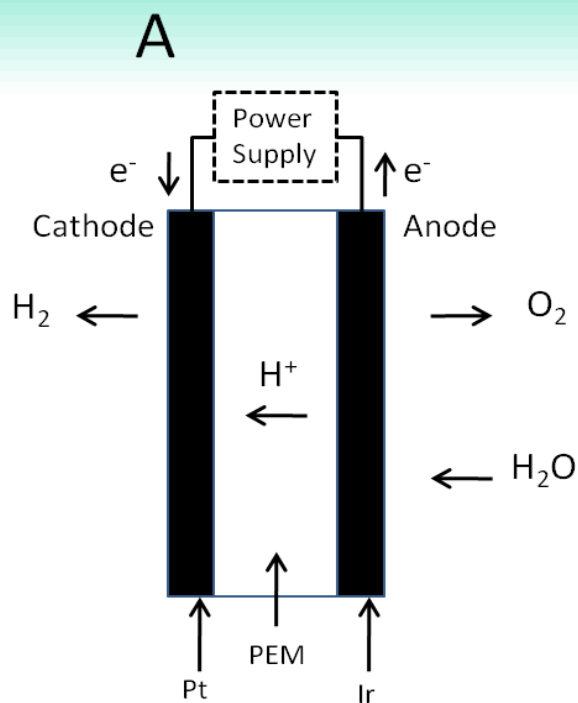
Using water and activator only

Technical data

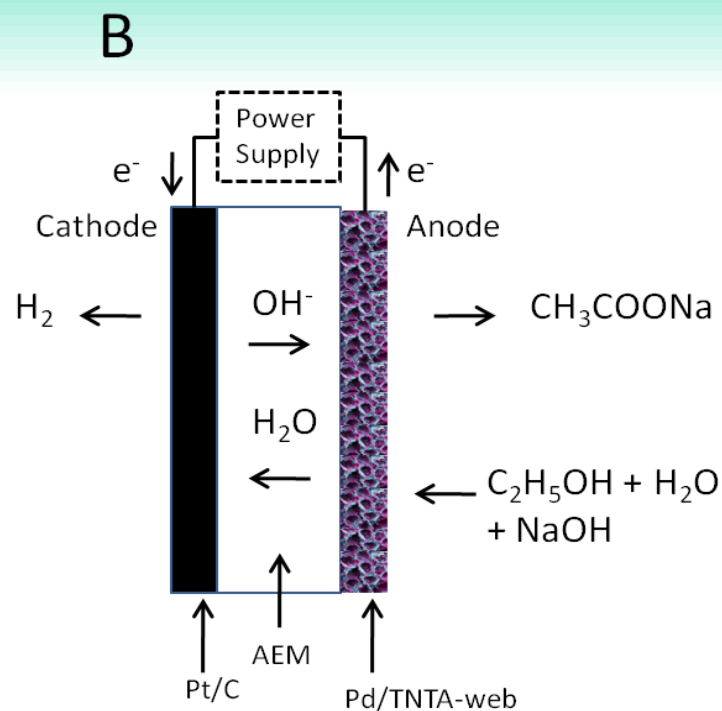
Nominal output power	200 W
Energy capacity	2.5 kWh
Hydrogen generation	2700 litri
Weight	50 kg



H₂: electrolysis from ethanol



48 kWh/kg of H₂



18,5 kWh/kg of H₂

Project EC FP7 DECORE, A. Lavacchi
HydroLab Project ECRF, F. Vizza

F. Vizza, A. Lavacchi, H.A. Miller, M. Bevilacqua, J. Filippi, M. Innocenti, A. Marchionni, W. Oberhauser, L. Wang, *Nature Communications*

<http://www.nature.com/ncomms/2014/140603/ncomms5036/abs/ncomms5036.html>



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**Idrogeno "pulito"
e a basso costo:
successo del CNR**



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Le Scienze

EDIZIONE ITALIANA DI SCIENTIFIC AMERICAN

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La fisica è in crisi?

Se LHC non conferma la supersimmetria,
la nostra visione del mondo va rivista
In edicola dal 2 luglio

ABBONAMENTI E RINNOVI



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23 luglio 2014

CNR: L'idrogeno ecologico ed efficiente

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Comunicato stampa - Sviluppato dall'Iccom-Cnr un sistema che produce idrogeno pulito con un risparmio energetico del 60%, grazie all'impiego di elettrodi nanostrutturati e alcol etilico. Diverse le potenziali ricadute tecnologiche. La ricerca è stata pubblicata su Nature Communications

SULLO STESSO ARGOMENTO

energia ambiente nanotecnologie

DAL SITO

05/04/2007

Un nanogeneratore che sfrutta l'energia dispersa

Roma, 23 luglio 2014 - Produrre idrogeno in maniera pulita, sicura ed efficiente a partire da soluzioni di alcoli rinnovabili. È il risultato raggiunto da un team dell'Istituto di chimica dei composti organometallici del Consiglio nazionale delle ricerche (Iccom-Cnr) di Firenze, diretto da Francesco Vizza e illustrato su 'Nature Communications'.

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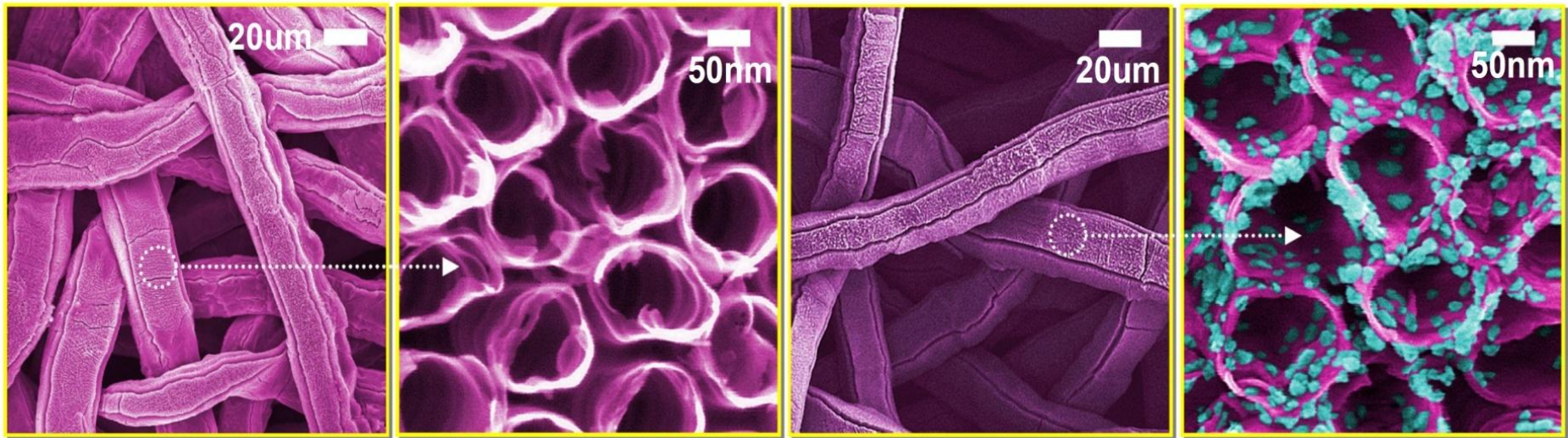
CONTATTI

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Chi siamo

Mente&cervello
IL MENSILE DI PSICOLOGIA E NEUROSCIENZE
Mente M&C luglio 2014

Pd on 3D Titania Nanotube Architecture for the electrolysis of renewable alcohols and for direct alcohols fuel cells



Titania Nanotube: diameter 100 nm; length 2.0 μm

Pd 10 nm

A. Lavacchi, F. Vizza, et al., *Nature Communications*

<http://www.nature.com/ncomms/2014/140603/ncomms5036/abs/ncomms5036.html>

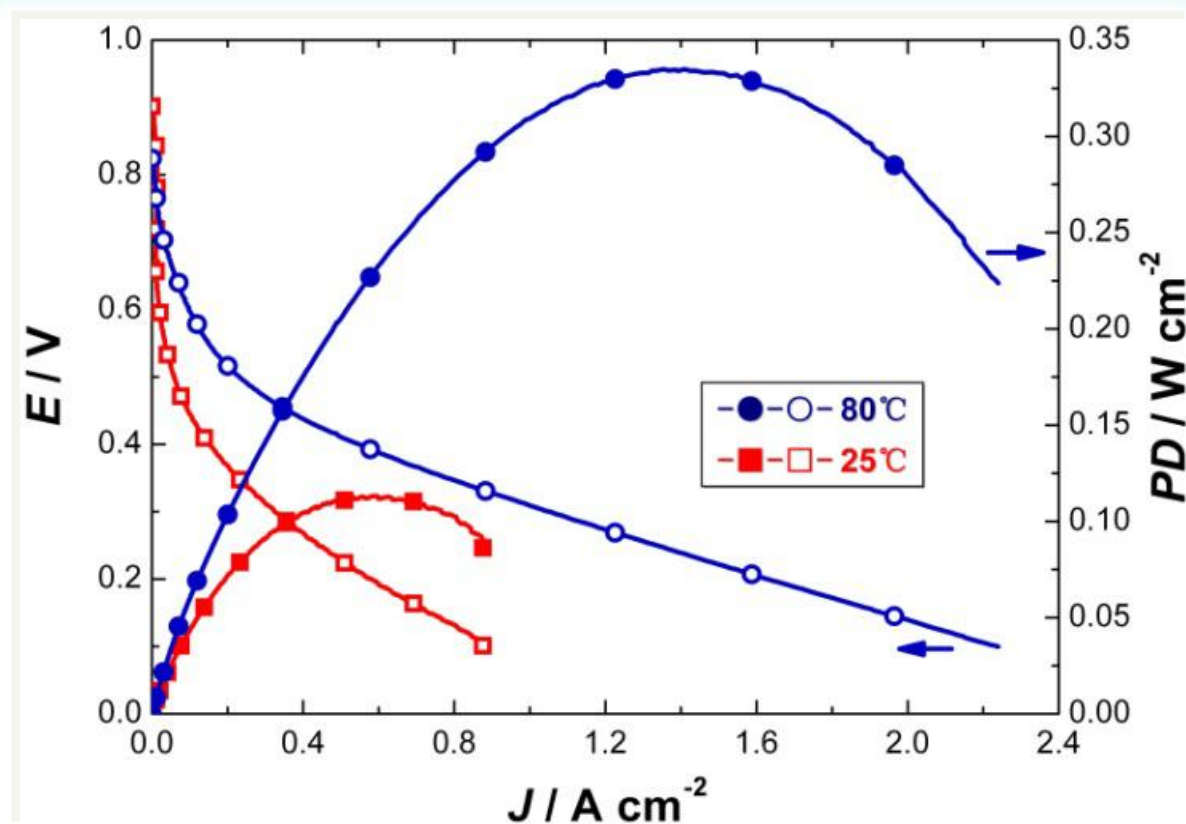
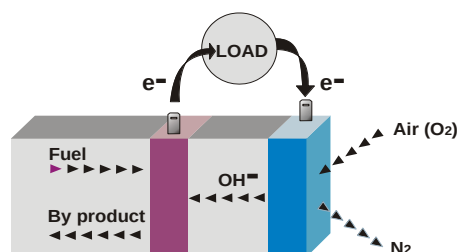
Pd on 3D Titania Nanotube Architecture for the electrolysis of renewable alcohols

Fuel	H2O	Ethanol	Ethylene Glycol	Glycerol	1,2-Propanediol
Cell Voltage	1.76	0.69	0.70	0.76	0.76
Energy Consumption (kWh kg ⁻¹ _{H2})	47.17	18.49	18.76	20.37	20.37

A. Lavacchi, Vizza F., et al., *Nature Communications*

<http://www.nature.com/ncomms/2014/140603/ncomms5036/abs/ncomms5036.html>

Pd on 3D Titania Nanotube Architecture for direct alcohols fuel cells



F. Vizza, et al., *J. Am. Chem. Soc.* submitted

F. Vizza, A. Lavacchi, H. Miller et al, *Nature Comm.* 2014; *Science (Highlights)* 2011; *Angew. Chem.* 2013; *Energy Envir. Science* 2012; *ChemSusChem* 2013; *P. Sources* 2012 ; *Angew. Chem* 2011; *Electrochem. Commun.* 2011; *ChemSusChem* 2012

Foundings

Progetto Europeo (DECORE)

CNR (EFOR, Premiale Energia)

Ente Cassa di Risparmio di Firenze (HYDROLAB)

MIUR (FIRB giovani)

Ministero Ambiente

Ministero Attività Produttive (Industria 2015: progetto PRIT)

Worgas Energy (progetto industriale: generatori portatili a idrogeno)

Progetto industriale azienda straniera: (microfuel cells e autotrazione)

Thanks