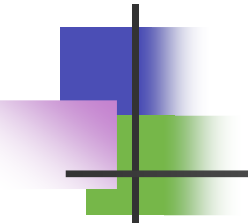


Dipartimento di Ingegneria Industriale  
UNIPA



***DEVELOPMENT OF  
NANOSTRUCTURED  
ELECTROCHEMICAL SYSTEMS  
FOR ENERGY STORAGE. A  
CASE STUDY OF  
TECHNOLOGY TRANSFER***





# Outline

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- *Presentation of APCL-UNIPA expertise*
- *Established Partnership*
- *New opportunities in the frame of projects funded by EU for underdeveloped areas (European Regional Development Fund)*



# Expertise of Applied Physical Chemistry

- *Fabrication of alumina membrane by aluminium anodizing*
- *Synthesis of nanostructured materials by template electrodeposition*

*Nanostructured Materials: Metals (Ni, Cu, Pb),*

*Alloys (SnCo, SnCu, PdCo, CuInGaSe<sub>2</sub>),*

*Oxides (Cu<sub>2</sub>O, CuO, RuO<sub>2</sub>,  $\alpha$ -PbO<sub>2</sub>,  $\beta$ -PbO<sub>2</sub>)*

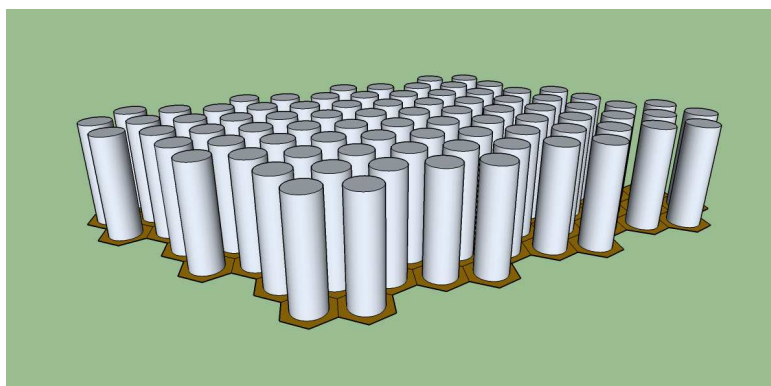
*Rare Earth Oxides (LnOx: La, Ce, Sm, Er)*



# Templates

*Typical templates: Anodic Alumina Membranes  
Polycarbonate Membranes*

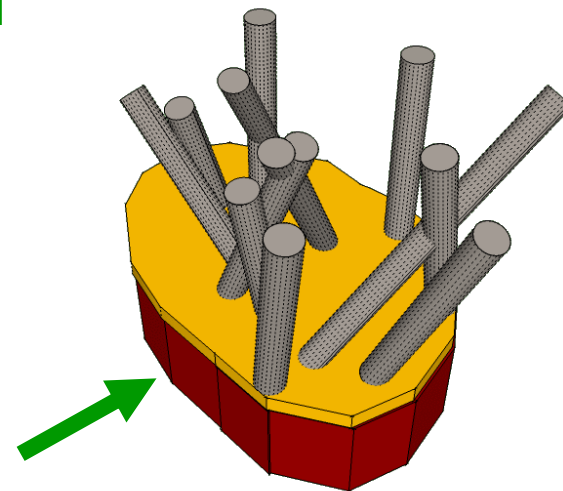
*Scientific Challenge: Electrodeposition in a  
confined ambient*



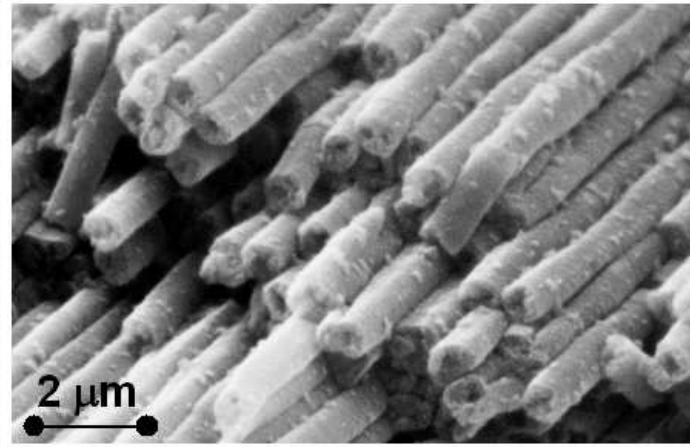
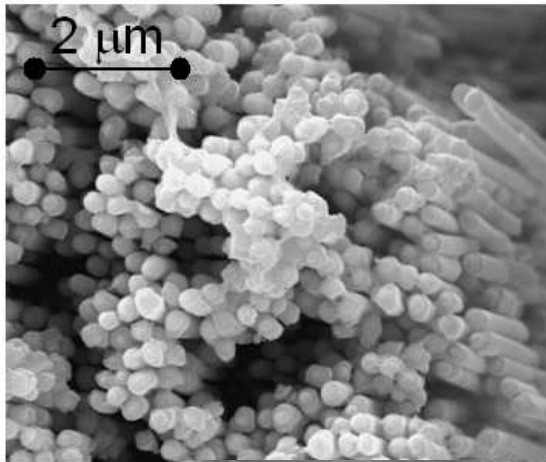
**Nanostructured  
Materials after  
Template  
Dissolution**

← **Alumina**

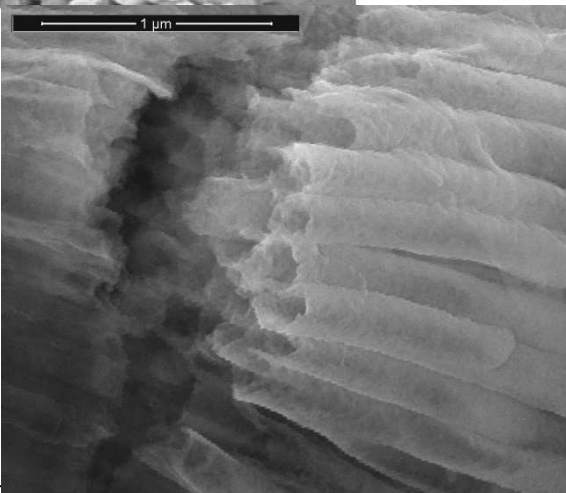
**Polycarbonate** →



# Morphology of some electrodeposited materials



**Ni NANOWIRES AND NANOTUBES**

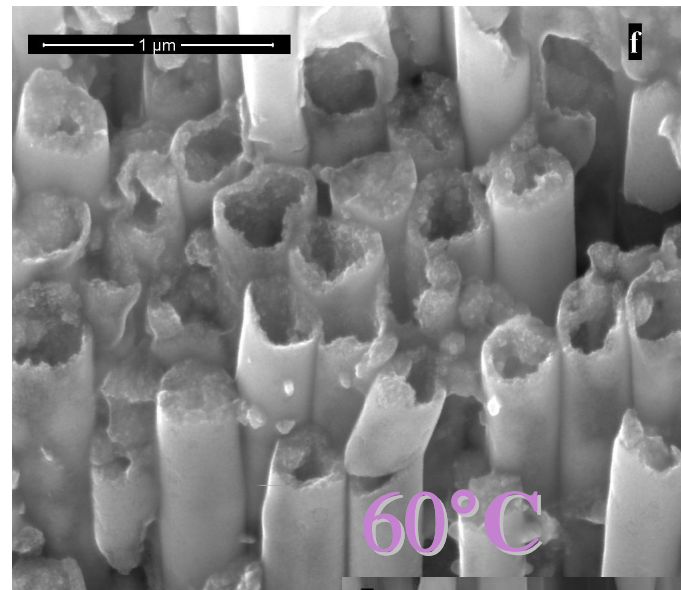
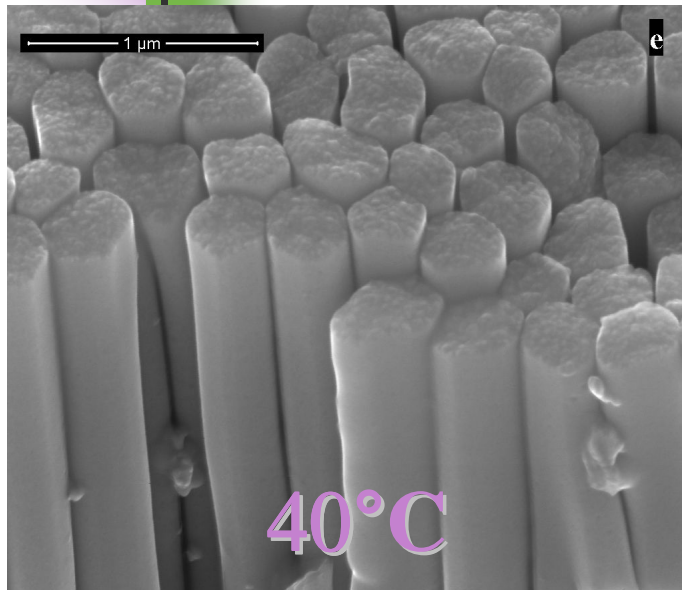


**CeO<sub>2</sub> NANOTUBES**

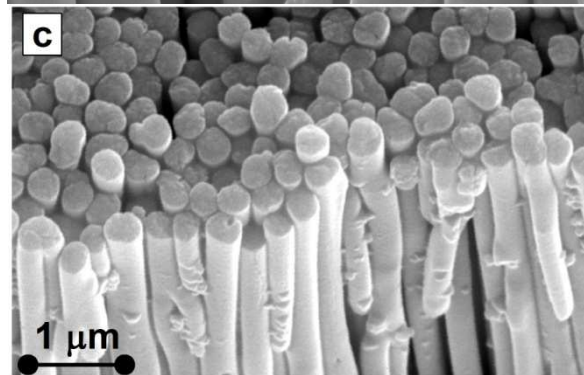


# Materials for Energy

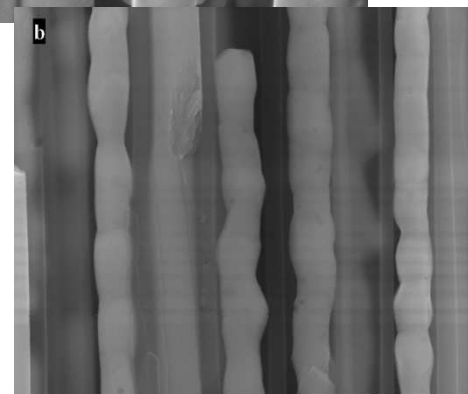
## Lead Acid battery



$\alpha\text{-PbO}_2$



$\beta\text{-PbO}_2$



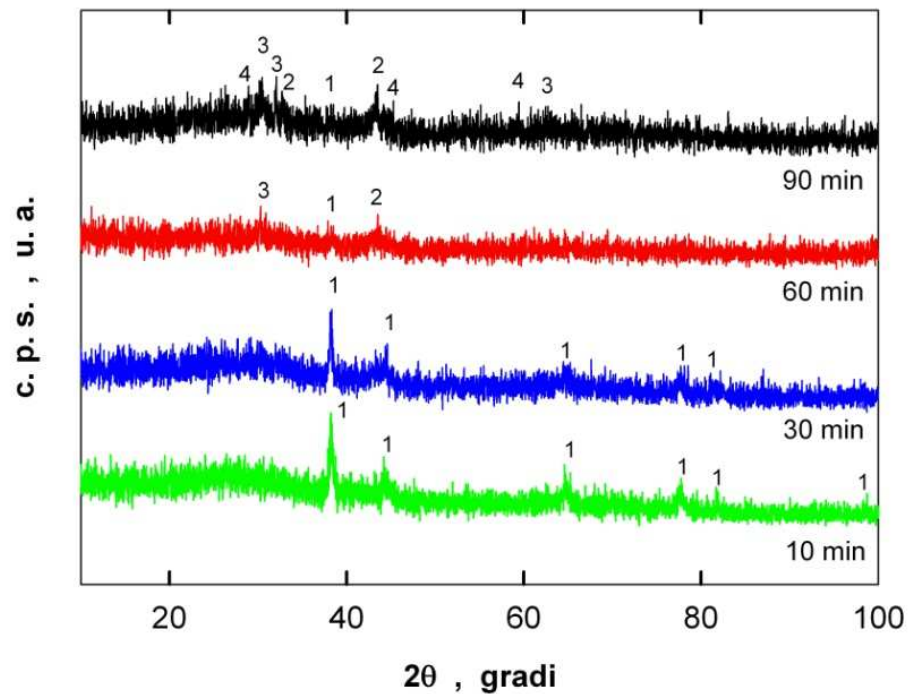
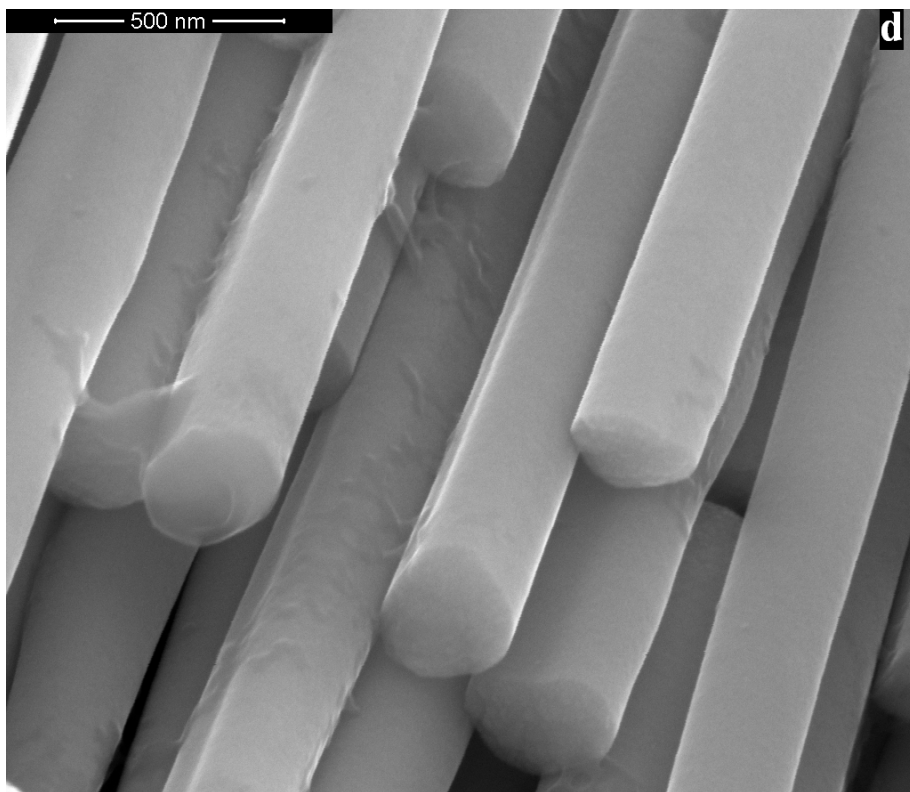
Pb





# Materials for Energy

## SnCo Anode for Li-ion battery



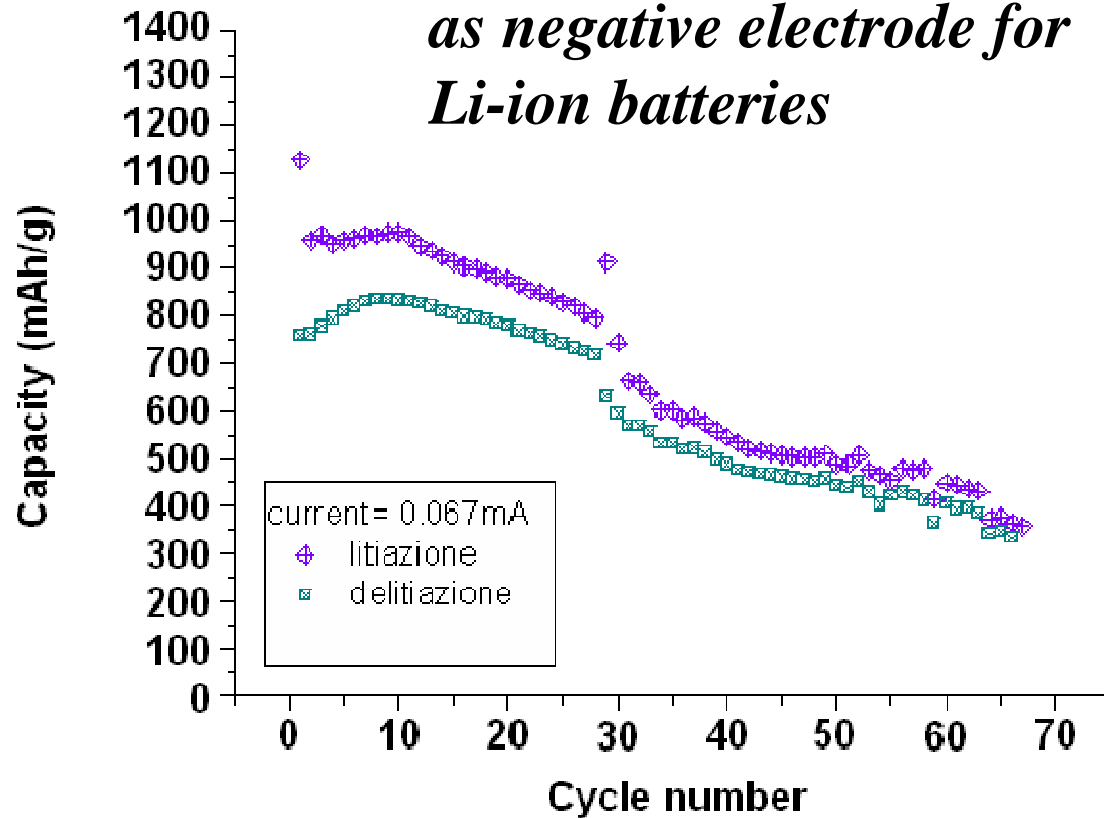
1 Au 4-784    2 CoSn<sub>2</sub> 65-2697    3 Sn 4-673    4 CoSn 65-3477



# Materials for Energy

## Performance of SnCo anode

*SnCo NWs (78% Sn w/o)  
as negative electrode for  
Li-ion batteries*



*Theoretical capacity  
value of Sn*

*994 mAh/g*



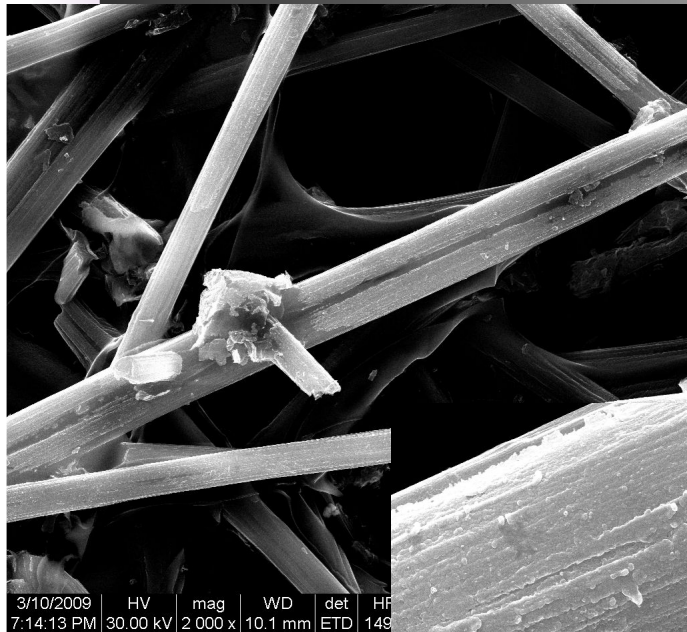
# Materials for Energy

## Absorbers for photovoltaic cells

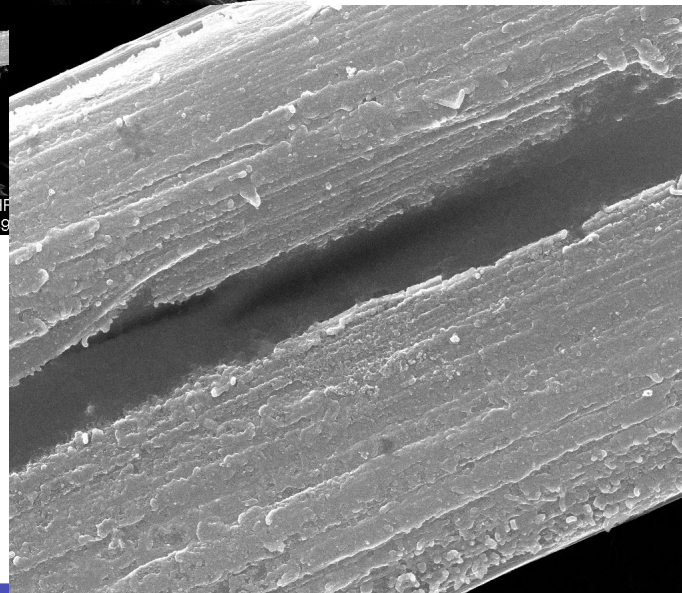


# Materials for Energy

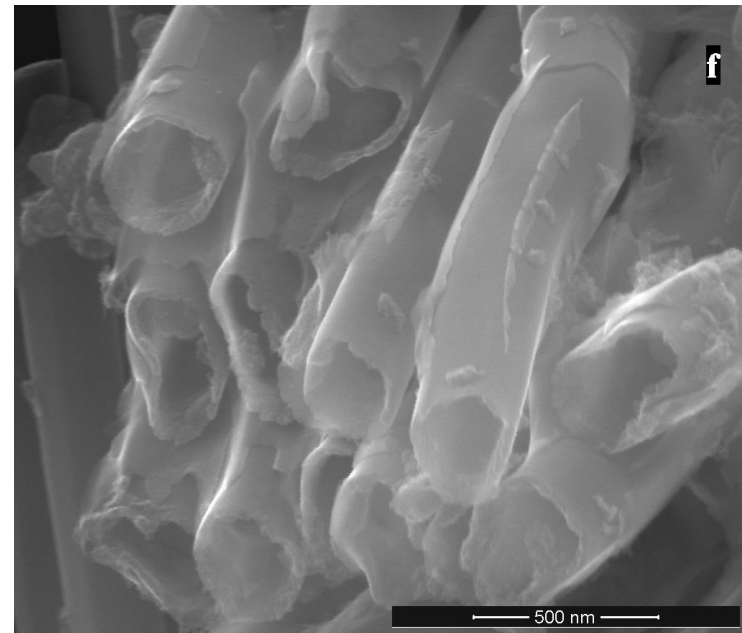
## Electrodes for water electrolysis



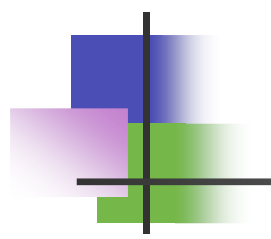
**RuO<sub>2</sub> on  
Carbon  
Paper**



**RuO<sub>2</sub> NANOTUBES**



# Partnership



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**In response to the call of January 2010 for enterprises operating in underdeveloped areas (PON 2007-2013 by MIUR), a partnership was established between UNIPA, CR Mo.S.S. (CR Mobility Solution Systems) and CR CHARG.ING (CR Charging Solar Infrastructures).**



# Enabling technologies



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Electric powertrain

Electric vehicle

Infrastructures for electric mobility



# Current activity on electric mobility at UNIPA-Engineering Faculty

## Education

**2° Level Master on Hybrid and Electric Propulsion Systems**

## Research

**Synthesis and characterization of nanostructured materials for  
development of Li-ion and Lead Acid Batteries**

**Currently, both activities are financially  
supported by the joined companies**





## Future plans

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**To strengthen the established join in view of new calls for educational and R&D activities in the field of electric mobility**







# Conclusions

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**The experience gained in the last year confirms that a join between research institutions, companies and venture capital (or, identically, private equity funds) may be of value in promoting technological innovation.**

**In this context, a valuable support may be given by the current calls published in <http://www.ponrec.it/bandi.aspx>**

**Of course, the University of Palermo is available to establish new partnerships with companies and financial institutions interested in starting or developing activities of technological innovation.**





## Final remarks

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***“... nanotechnology can considerably help human capability to reduce the impact of energy production, storage and use. Even if we are still far away from a truly sustainable energy system, scientific community is looking at a further development of energy nanotechnologies by 21<sup>st</sup> century. ...”***

*E. Serrano et al.*

*Renewable and Sustainable Energy Reviews, 2009*





# Contact

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**Mobile:** +39-3204328573

