

Final Report

SOLFACE

High Flux Solar FACilities for Europe

Transnational Access
implemented as
Specific Support Action

Contract number: *RITA-CT-2003-507091*

Project coordinator: *Gabriel OLALDE - PROMES-CNRS*

Project website:

<http://www.promes.cnrs.fr/solface/>

Project Duration : *48 months from 01/01/2004 to 31/12/2007*

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under the “Structuring the European Research Area” specific programme
Research Infrastructures Action**

A. ACTIVITY REPORT

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1. Project Objectives

During years 2004 - 2007, in the frame of the 6th Framework Programme "Integrating Activities - Transnational Access" of the European Commission, **SOLFACE** proposes to public or industrial European scientists to access, free of any charge, the PROMES-CNRS's high flux solar facilities at Font-Romeu - Odeillo, France to:

- the MegaWatt solar furnace (**MWSF**),
- and the 11 Medium Size Solar Furnaces (**MSSFs**),

their associated experimental devices, their related diagnostic instruments, and high level materials characterization techniques. Each year, users proposals were examined by the international Users Selection Panel (USP), and the selected projects gain access to the facilities.

High-temperature research may be performed using highly concentrated solar energy (3000 to more than 15000 "suns") in many domains. Among these, the more interesting areas are thermo-chemical cycles for energy storage, production of environmentally benign energy carriers (H₂, Syngas, ...), high flux photo-chemistry, high value added material synthesis (nano-structured materials, ceramic, glass, ...), knowledge-based behaviour of multifunctional materials under extreme conditions.

PROMES-CNRS has conducted research in the field of highly concentrated solar energy during more than 50 years, first in Mont-Louis, then in Font-Romeu - Odeillo. A large number of thematic research in this field was initiated for the first time at the Institute.

SOLFACE, hosted by PROMES-CNRS, offers to perform high quality research in two of the seven FP6 Priority Thematic Areas:

- Area 3: Nano-technologies and nano-sciences, knowledge-based functional materials, new production process and devices. The following are addressed:
 - the understanding of the basic phenomena and the mastering of the elaboration processes of nano-structured materials (fullerenes, C-nanotubes, ceramics),
 - the synthesis of knowledge-based high value added material (ceramics, glass, ...),
 - the fundamental behaviour of multifunctional materials under extreme conditions.
- Area 6: Sustainable development, global change and ecosystems. Research is related to:
 - the solar production of benign chemical energy carriers (H₂, Syngas, ...),
 - cycles for chemical storage of solar energy ,
 - the capture and the sequestration of CO₂.

New highly promising and original research domains, some of them unexplored, are presently studied at the Laboratory, hence creating a unique top level working atmosphere. Among them:

- fundamental studies of the solar photo-excitation and the solar photo-luminescence of gaseous species for the accurate analysis (temperature, composition) of the gas phase at the interface with the condensed phase during high temperature solar processes,
- solar synthesis methods for the production of nano-structured materials, from the understanding of the elementary growing mechanisms to the identification and the mastering of the main parameters for the up-scale production,
- simulation of the extreme conditions occurring during high temperature processes and spatial applications for the study of the physico-chemical behaviour and of the thermo-physical properties of materials.

Other new research domains, quite unexplored at the international level and still not studied at PROMES-CNRS, were opened by external scientists hosted through this project: for example, the

test of laser generation in die solutions under direct solar pumping, the study of photon-matter interaction during material processing in plasma and laser radiation processes...

2. Description of the facilities and selection procedure

2.1 Quality of the infrastructure

SOLFACE facilities of PROMES-CNRS at Odeillo offer a whole range of high and very high flux solar furnaces. They are associated with a large variety of modular reactors and equipments at focus, designed and developed at the Institute, to perform in the best conditions high level research in a very large scientific domain. Furthermore, an extended set of in-situ diagnostic apparatus and of advanced material analysis and characterization techniques, complete the infrastructure.

The facilities are perfectly suited to support high-risk - high-gain fundamental research as well as more established mature research at an industrial pilot scale. The easy availability of high heat flux and/or high temperatures without contamination, and the atmosphere control (pressure, including secondary vacuum, composition), make these facilities unique for the study of: the synthesis of knowledge-based materials, solar chemical processes, solar chemical energy storage cycles, the thermophysical behaviour of materials under extreme conditions, fundamental high flux physics, ...

This rich work has been possible as the laboratory operates a unique set in the world of very high concentration solar furnaces (Figure 1) associated with original experimental apparatus and specific diagnostic devices.

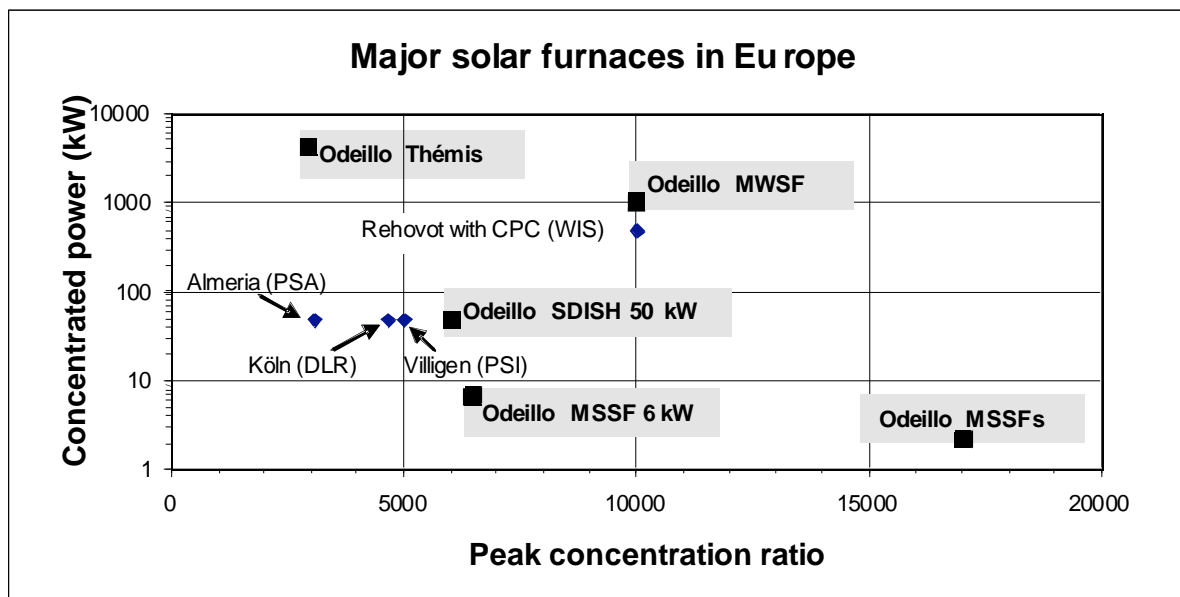


Figure 1: Major solar furnaces in Europe

The MWSF (Figure 2) is the more powerful solar furnace in the world: power up to 1 MW, peak heat flux around 10000 kW/m² at focus (Figure 4), peak temperature above 3000 K. The modular set-up of the facility allows to work with a wide range of power levels from a few dozen kW up to the full-rated power of 1 MW.



Figure 2: The MWSF (Megawatt Solar Furnace)

Several modular experimental apparatus are available at focus, particularly:

- MEDIASE, a chamber permitting high temperature heating under secondary vacuum or controlled atmosphere, additional ion and/or UV irradiation, material thermophysical characterization: qualitative and quantitative mass loss, directional spectral or total thermo-radiative properties,
- MECARBSOL, a pilot reactor for the synthesis of carbon complex molecules (fullerenes) and carbon nano-structured materials (nanotubes) under controlled atmosphere.

A complete set of diagnostic instruments (optical or optical fibre pyrometers, radiometers and spectro-radiometers, mass spectrometers, quartz-crystal microbalance, ...), and a performing data acquisition system, complete the equipment.

The **MSSFs** is a set of 12 medium size solar furnaces from 1 to 50 kW:

- One 50 kW solar dish (SDISH 50kW), offering a peak flux of 6,000 suns (Figure 3). This facility is daily operated with a Stirling machine for electrical production; this integrated system can be either used or removed for the accesses offered, depending on the goal of the user.
- One mid-scale solar facility (MSSF), which has been operated for more than 30 years: power 6 kW, peak flux 5,000 suns, including a shutter to finely modulate the concentrated solar power (Figure 4).
- Ten mid-scale facilities (MSSFs), which have been operated for more than 40 years: power 1 or 2 kW, peak flux 16,000 suns, allowing temperatures largely beyond 3,500 K (Figure 5). Two of this furnaces are with a horizontal axis, the eight remaining being vertical axed. Most of these furnaces are equipped with shutters to easily modulate the power as needed.

The irradiation of several facilities is monitored with shutters or flux regulators, among them the last generation "SÉSAME" with carbon composite blades which allows full modulation of the power as fast as one fifth of second, and the shutter at the 6 kW MSSF with speed down to two third of second. These shutters are notably being used for closed loop adaptative temperature control research; automatic flux control and automatic cycles programmable command systems are also currently being developed



Figure 3: The 50 kW solar dish (SDISH 50kW)



Figure 4: The MSSF 6 kW



Figure 5 The MSSFs 1 or 2 kW

MSSFs are equipped with versatile mountings to support foreign experimental apparatus and are diversely equipped with devices, chambers and reactors, among others:

- MESOX, a chamber adapted to the 6 kW solar furnace for the study of the heterogeneous catalysis, molecular or atomic oxidation kinetics of materials under plasma atmospheres up to 2300 K,
- DISCO, a device for the measurement of materials reflectivity evolution at temperatures up to 2500 K and its correlation with the surface behaviour (aging, ablation and oxidation),
- GINOSOL, a prototype reactor for the synthesis of carbon complex molecules (fullerenes) and carbon nano-structured materials (nanotubes) by evaporation-condensation of carbon above 3000 K under primary vacuum or controlled atmosphere,
- MANOSOL, a reactor for the preparation of inorganic nanomaterials by evaporation-condensation above 3000 K under primary vacuum, oxidising or controlled atmosphere,
- SPESOL, reactors for the high speed quenching of melted materials using the splat-cooling method (10^5 K/s) or the immersion method (10^4 K/s),
- ROTSOL, a rotating cavity reactor for the melting of high purity materials in self crucible up to 3000 K under oxidising or controlled atmosphere and for the thermal analysis of freezing process,

- PVDSOL, a Physical Vapour Deposition solar reactor under secondary vacuum for the preparation of thin solid films from a vaporization-condensation process,
- TOYSOL, a multi-purpose reactor for the heating and/or melting of solid or powder materials up to 3000 K under oxidising or controlled atmosphere,
- SURFSOL, a high temperature reactor for flash or transient surface heat processing under vacuum or controlled atmosphere,
- EXCSOL, a high temperature reactor under controlled atmosphere for the study by optical spectroscopy (OES) of the solar photo-excitation and the solar-induced photoluminescence in the vapour surrounding partially melted materials,
- PROPSOL, a multipurpose chamber under secondary vacuum or controlled atmosphere for the determination of thermo-physical properties (conductivity, thermo-radiative properties), the realisation of thermal shocks and of thermal processing up to 2300 K.

SOLFACE's MWSF and MSSFs are associated to:

- High quality online and offline diagnostics: optical or fiber optic pyrometry, fiber optic pyro-reflectometry, radiometry and spectro-radiometry, infrared spectrometry, infrared camera, mass spectrometry, optical spectroscopy, IR gas analysis, IRTF gas chromatography, OES, ICP-MS...
- High precision fast calorimeters suited to the wide possible range of the furnaces operating conditions, optical flux measurement based on real-time image analysis,
- Advanced materials analysis and characterization techniques: SEM, XPS, AES, ELS, XRD, EPMA (EDS, WDS)...
- Quality data acquisition systems for the common signals and automatic control systems for simple processes
- Actinometric and weather station with a fine continuous archiving of all the data, notably up to 1 Hz for the recorded solar parameters — direct normal, global and diffuse irradiations.

All these instrumentation and characterization devices and techniques are currently operated by laboratory both high level and experienced scientific and technical staff.

SOLFACE offers access to a unique and original combination of:

- numerous high flux solar concentrators and coupled modular reactors,
- concentrated power range from 1 kW to 1 MW,
- associated diagnostics and materials characterisation techniques,
- scientific skills,
- high quality sunny climate.

The world-class quality of SOLFACE is that no other laboratory in the world allows to benefit from the whole of these assets.

2.2 Selection Procedure

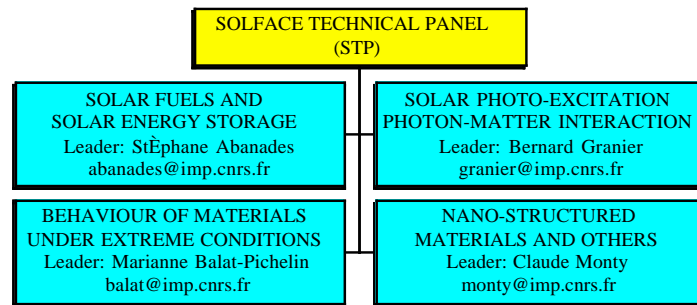
The selection procedure to access SOLFACE was annual.

In the first step, the candidates wishing to access SOLFACE were asked to express their interest by filling the User Proposal Form (UPF). The form was available at the website of SOLFACE or was mailed or faxed upon request. It was composed of three parts: the first one to identify clearly the

candidate, the second one to describe the scientific activity and experience, the third one to expose accurately the work to realize during the access to SOLFACE and the requested facility to access.

In the second step, each proposal was evaluated technically by the SOLFACE Technical Panel (STP) led by the scientist responsible of the concerned research area at PROMES. The STP was divided into 4 activity domains:

- Solar fuels and solar energy storage (leader: Dr. Stéphane Abanades),
- Solar photo-excitation, photon-matter interaction (leader: Dr. Bernard Granier),
- Behavior of materials under extreme conditions (leader: Dr. Marianne Balat-Pichelin),
- Nano-structured materials and others (leader: Dr. Claude Monty).

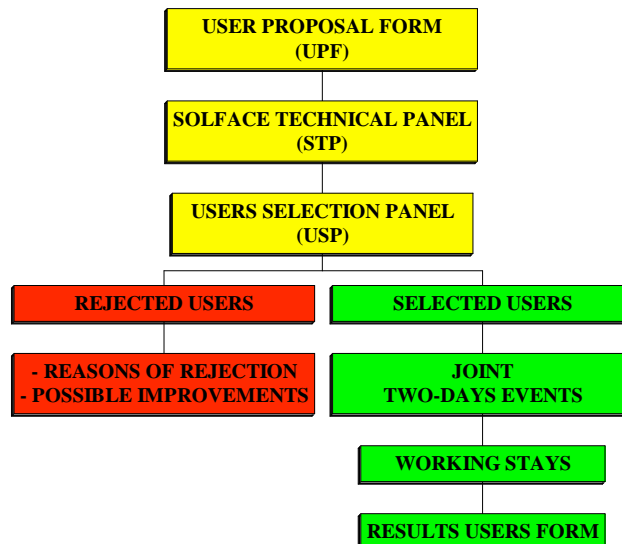


This evaluation is based exclusively on the technical possibilities of SOLFACE to address the proposal.

In the third step, the proposals were submitted, joined with their STP evaluation, to the Users Selection Panel (USP) composed of 5 international high grade international experts: 1 from France and 4 from other European countries. All experts are independent from PROMES-CNRS: three of them are aware of the specific research areas developed at the Institute and two of them are experts in scientific domains outside the ones of PROMES-CNRS. The SOLFACE Project Manager is a member of USP but acts as the secretary only.

The selection of users mostly occurred through direct contacts between the members by emails and phone calls, to exchange freely their opinion and decide in all fairness of the selected proposals. The selection was established on the basis of the scientific merit of the proposals, without any restriction of scientific domain, with a special care to give access to research areas which are outside the present fields of interest of PROMES-CNRS.

The rejected proposals were notified by mail to the candidate with detailed reasons of the rejection and suggestions of improvement.



Such a procedure insured the transparency, the fairness and the impartiality of the selection.

The selected proposals met then with SOLFACE staffs during a annual **Joint Two-Day Event** (General Users Round Table Meeting and Users Workshop) to participate to a basic training course on the facilities and to discuss details of the projects and their implementation. They also met former users to discover their past experience with SOLFACE: indeed, the participants are required to fill a result form after their stay, with the main results of their work and its foreseen exploitation, and to present their work the year after, to the next Joint Two-Day Event.

3. Access provided

The effective access provided during the four years was definitely much higher compared to the terms of the contract.

SOLFACE was expected to receive a minimum of **24 projects** and **48 users** for the four years.

Thanks to a good financial management of the contract and the great scientifically interest expressed by the European users, we had the possibility to host supplementary projects during the four years.

In summary, the program had a really great success, with 30% more projects and 70% more users than targeted.

Proposal Number ¹	507091	Proposal Acronym ²	SOLFACE
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Minimum of Access to be Provided

Implementation Plan											
Participant n°	Organisation short name	Short name of the Infrastructure	Installation (s)		Country code of operator	Cost model used for Access (UF / AC)	Unit cost (in €)	Unit of access	For the whole duration of the project		
			Number (s)	Short name (s)					Minimum quantity of access to be provided	Estimated number of users	Estimated number of user groups
1	CNRS	IMP-CNRS	1	MWS F	F	UF	7873	Exp. Week	10	8	4
1	CNRS	IMP-CNRS	2	MSS Fs	F	UF	2157	Exp. Week	50	40	20
TOTAL									60	48	24

Effective Access Provided

Implementation Plan											
Participant n°	Organisation short name	Short name of the Infrastructure	Installation (s)		Country code of operator	Cost model used for Access (UF / AC)	Unit cost (in €)	Unit of access	For the whole duration of the project		
			Number (s)	Short name (s)					Quantity of access to be provided	Number of users	Number of user groups
1	CNRS	IMP-CNRS	1	MWS F	F	UF	7873	Exp. Week	8	16	5
1	CNRS	IMP-CNRS	2	MSS Fs	F	UF	2157	Exp. Week	57	67	27
TOTAL									65	83	32

The balance for the period of the contract was:

- **32 research projects have been hosted,**
- **83 scientists (users) from 10 European countries (Spain, Portugal, Italy, Germany, Poland, Romania, Latvia, Slovenia, Greece...) have taken part in the program,**
- **More than 60 scientific articles and international communications have been published so far.**

The thirty two research projects hosted during the four years SOLFACE project were:

- **1.FOMASOL: Foam materials as volumetric receivers for solar radiation.**
 - Scientific field: Material Science
 - Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece.
 - Project Leader: Prof. N. Michailidis
 - One working stay for two scientists at SOLFACE from 02/09 to 08/09/2007: N. Michalidis, D. Misirlis
 - One working stay for one scientist at SOLFACE from 02/09 to 15/09/2007: C. Almpanakis
- **2.INTER-TPS: Characterization of Intermetallic materials for TPS applications.**
 - Scientific field: Material Science for space applications
 - *INASMET – TECNALIA, Spain*
 - Project Leader: Dr M.B. Caflanca
 - One working stay for two scientists at SOLFACE from 16/09 to 21/09/2007: B. Caflanca, G. Atxaga.
 - One working stay for two scientists at SOLFACE from 07/10 to 12/10/2007: D. Garbarain, Y. Justo.
- **3.LUMNASOR: Luminescent nanopowders obtained by vaporization-condensation in a solar reactor.**
 - Scientific field: Material Science
 - University of Latvia
 - Project leader: Dr. L Grigorgeva.
 - One working stay for two scientists at SOLFACE from 15/07 to 04/08/2007: K. Smits, V. Pankratov.
 - One working stay for one scientist at SOLFACE from 15/07 to 28/07/2007: J. Fidelus.
- **4.TEFUMAH: High temperature treatment of fusion relevant materials in hydrogen plasma.**
 - Scientific field: Physics
 - Jozef Stefan Institute, Jamova 39, 1000, Ljubljana, Slovenia
 - Project Leader: M. Mozetic
 - One Working stay for one scientist at SOLFACE from 26/09 to 02/10/2007: Miran Mozetic.
 - One Working stay for two scientists at SOLFACE from 23/09 to 05/10/2007: A. Vesel, A. Drenik.
- **5.SOLCONTROL: Adaptive Temperature Control of a Solar Furnace.**

- Scientific field: Physics
- INESC-ID/IST, Portugal.
- Project Leader: J. Lemos
- One Working stay for two scientists at SOLFACE from 12/02 to 14/02/2007: J. Lemos, B. Costa.
- One Working stay for one scientist at SOLFACE from 02/09 to 22/09/2007: B. Costa.
- One Working stay for one scientist at SOLFACE from 09/09 to 15/09/2007: J. Lemos.

- **6.TACSA: Aging Tests and Assessment of Ceramic Solar Absorbers**

- Scientific field: Material Science
- CIEMAT, Madrid Spain
- Project Leader: Dr. Maria Gonzalez
- One Working stay for one scientist at SOLFACE from 24/08 to 01/09/2007: M. Gonzalez.
- One Working stay for one scientist at SOLFACE from 26/08 to 05/09/2007: M. Pfänder
- One Working stay for one scientist at SOLFACE from 26/08 to 30/08/2007: R. Amado.

- **7.NANODMS: Elaboration, characterization and Magnetic properties of magnetic metal doped TiO₂ nanophases**

- Scientific field: Material Science
- ICMAB, Barcelona, Spain
- Project Leader: L. Balcells
- One Working stay for two scientists at SOLFACE from 24/06 to 29/06/2007: C. Boubeta, C. Balcells.
- One Working stay for one scientist at SOLFACE from 02/09 to 04/09/2007: C. Balcells.
- One Working stay for one scientist at SOLFACE from 02/09 to 07/09/2007: C. Boubeta.

- **8.SOFRECCO: Solar Furnaces for Reaction-bonding of Ceramic Coatings**

- Scientific field: Material Science, Space applications
- DLR, Cologne, Germany
- Project Leader; P. Mechnich
- One Working stay for one scientist at SOLFACE from 01/07 to 14/07/2007: P. Mechnich
- One Working stay for one scientist at SOLFACE from 08/07 to 14/07/2007: M. Schmucker

- **9.GLACER: Fabrication of glass ceramics using waste materials.**

- Scientific field: Material Science
- Aristotle University of Thessaloniki, 54124, Thessaloniki, Greece.
- Project Leader: Prof. Dimitris TSIPAS
- One working stay for two scientists at SOLFACE from 17/07 to 25/07/2006: Yiannis Flitris, Dimitris Tsipas
- One working stay for one scientist at SOLFACE from 17/07 to 28/07/2006: Konstantinos Vasilopoulos

- **10.LUMINANOS: Luminescence properties of ZnO based nanophases.**
 - Scientific field: Material Science
 - Institute of Solid State Physics, University of Latvia, 8 Kengaraga str., LV-1063, Riga, Latvia
 - Project Leader: Dr Larisa GRIGORJEVA
 - One working stay for two scientists at SOLFACE from 26/07 to 30/07/2006: Larisa Grigorjeva, Donats Millers.
 - One working stay for one scientist at SOLFACE from 26/07 to 08/08/2006: Smits Krisjanis.

- **11.NANOCOATS: ZnO based Nanostructural Coatings an thin films.**
 - Scientific field: Material Science
 - University of Pitesti, N°.1, Targul Din Vale, Arges, Pitesti Romania
 - Project leader: Marioara ABRUDEANU.
 - One working stay for one scientist at SOLFACE from 26/07 to 28/07/2006: Marioara Abrudeanu.
 - One working stay for one scientist at SOLFACE from 26/07 to 07/08/2006: Gabriela Plaiasu

- **12.OXYMET: Oxidation of metal samples at extreme conditions.**
 - Scientific field: Physics
 - Jozef Stefan Institute, Jamova 39, 1000, Ljubljana, Slovenia
 - Project Leader: Alenka Vesel
 - One Working stay for one scientist at SOLFACE from 05/09 to 11/09/2006: Miran Mozetic.
 - One Working stay for two scientist at SOLFACE from 04/09 to 15/09/2006: Alenka Vesel, Aleksander Drenik.

- **13.SEAM: Solar energy assisted by self-propagating high temperature synthesis for surface modification**
 - Scientific field: Material Science
 - CENIM-CSIC, Avda. Gregorio del Amo, 8. 28040 Madrid Spain.
 - Project Leader: Alfonso J. Vázquez Vaamonde
 - One Working stay for two scientists at SOLFACE from 26/07 to 07/08/2008: Carlos Sanchez , Javier Llorente.

- **14.TALT: Towards accelerated life tests for CSP components with contact-less optical sensing**
 - Scientific field: Material Science
 - DLR-Institute for Materials Research, Linder Höhe, D-51147 Köln, Germany
 - Project Leader: Markus Pfänder
 - One Working stay for two scientists at SOLFACE from 04/09 to 8/09/2006: Martin Schmücker, Peter Mechnich.
 - One Working stay for one scientists at SOLFACE from 04/09 to 15/09/2006: Markus Pfänder

- **15.UHTC-SHS: Ultra High Temperature Ceramics for Sharp Hot Structures**
 - Scientific field: Material Science

- CIRA, scpa Advanced Materials & Manufacturing Technologies, Via Maiorise, 81043, Capua, Italy
- Project Leader: Luigi Scatteia
- One Working stay for two scientists at SOLFACE from 17/07 to 28/07/2006: David Alfano, Giovanni Consentino.

- **16.CHIC New corrosion resistant Coatings processed by High Concentrated solar energy**

- Scientific field: **Material Science**
- **Universidad of Castilla-La Mancha, Applied Mechanics**, Avd Camilo Jose Cela s/n, E-13071 Ciudad Real, España
- Project Leader: **Gloria Rodriguez**
- One working stay for two scientists at SOLFACE from 6/03 to 12/03/2005: Gloria Rodriguez, Christina Casado.
- One working stay for one scientist at SOLFACE from 6/03 to 20/03/2005: Carlos Sanchez.
- One working stay for two scientists at SOLFACE from 13/03 to 21/03/2005: Alfonso Vasquez, Christina Sierra.

- **17.LTC-C1 Towards accelerated life tests for CSP components with contactless optical sensing**

- Scientific field: **Physics**
- **DLR Solar Research, Plataforma Solar de Almeria**, Apartado 39, E-04200 Tabernas, Almeria, España
- Project Leader: **Eckhard Lüpfert**
- One Working stay for two scientists at SOLFACE from 11/04 to 23/04/2005: Eckhard Lüpfert, Markus Pfänder.

- **18.NANOMAT Nanomaterials for coating: elaboration by splat-cooling in a solar furnace and ball-milling**

- Scientific field: **Material Science**
- **AGH University of Science and Technology, Faculty of Metallurgy and Materials Science**, Al A. Mickiewicza 30, 30-059 Krakow, Poland:
- Project leader: **Jan Kusinski**,
- One working stay for one scientist at SOLFACE from 06/03 to 10/03/2005: Slowomir Kac.

- **19.POWERFLUX New flux mapping system for concentrated sunlight**

- **DLR German Aerospace Center, Solar Research**, Linder Höhe, 51170 KÖLN, Germany
- Project Leader: **Andreas Neumann**
- Scientific field: **Physics**
- One Working stay for one scientist at SOLFACE from 6/03 to 19/03/2005: Christian Willsch.
- One Working stay for one scientist at SOLFACE from 13/03 to 17/03/2005: Andreas Neumann.

- **20.DYELASER High efficiency concentrated solar radiation pumped dye laser operation for Magnetic Resonance imaging**

- Scientific field: **Physics**

- **Universita di Milano Bicocca, Dpt of Material Science, Via Cozzi, 53, 20125**
Milano, Italia
- Project Leader: **Marziale Milani**
- One Working stay for three scientists at SOLFACE from 6/03 to 19/03/2005:
Marziale Milani, Guliana Baroni, Lorenzo Ferraro.

- **21.NANOSICON Solar furnace sintering of nanostructural ceramic based on silicon nitride / silicon carbide**

- Scientific field: **Material Science**
- **Riga Technical University, Institute of Inorganic Chemistry, 34, Miera Str., LV-2169** Salaspils, Latvia
- Project Leader: **Ilmars Zalite**
- One Working stay for two scientists at SOLFACE from 6/03 to 22/03/2005: Ilmars Zalite, Natalja Zilinska

- **22.MAGNANOS Elaboration, characterization and magnetic properties of Co and Mn doped ZnO nanophases**

- Scientific field: **Material Science**
- **Instituto de Ciencia de Materiales de Barcelona (ICMAB-CSIC), Department of Magnetic and Superconducting Materials, Campus de Bellaterra, E-08193** Bellaterra, España
- Project Leader: **Benjamín Martínez**
- One Working stay for two scientists at SOLFACE from 25/04 to 29/04/2005: Benjamin Martinez and Lluís Balcells

- **23.METLAYABS Estimate of the solar absorption factor for metallic layers under the action of a short flash of concentrated solar energy**

- Scientific field: **Physics**
- **University of L'Aquila, Dipartimento di Energetica, L'Aquila, Italia**
- Project Leader: **Filippo de Monte**
- One Working stay for one scientist at SOLFACE from 16/05 to 20/05/2005: Paolo Rosa.

- **24.SOLARSYNT Carbide synthesis of d-group transition metals and further studies on ceramics using the solar spectral radiation**

- Scientific field: **Physics**
- **IST Instituto Superior Técnico, Departamento de Engenharia de Materiais, Lisboa, Portugal**
- Project Leader: **Luis Guerra**
- One working stay for two scientists at SOLFACE from 16/07 to 23/07/2005: Jose Fernandez, Fernando Oliveira.
- One working stay for one scientist at SOLFACE from 16/07 to 24/07/2005: Nobu Shohoji.

- **25.HELIONANOS Development of ZnO based nanomaterials for applications in optoelectronic and spintronic**

- Scientific field: **Physics**
- **National Inst. for Non-ferrous & Rare Metals, Pantelimon, Iifov, Romania**
- Project Leader: **Radu Piticescu**

- One working stay for two scientists at SOLFACE from 17/07 to 30/07/2005: Radu Piticescu, Laura Popescu.

- **26.PAD Performance analysis of a DishStirling system**

- Scientific field: **Energy**
- **DLR/PSA - Plataforma Solar de Almeria**, Tabernas, Spain
- Project Leader: **Peter Heller**
- One working stay for three scientists at SOLFACE from 24/07 to 5/08/2005: Steffen Ulmer, Thorsten Rauch and from 10/10 to 13/10/2005: Peter Heller
- Two working stays for one scientist at SOLFACE from 24/07 to 5/08/2005 and from 10/10 to 13/10/2005, Wolfgang Reinalter.

- **27.ROAST Recombination of oxygen atoms on surfaces at high temperatures**

- Scientific field: **Physics**
- **Jozef Stefan Institute**, Ljubljana, Slovenia
- Project Leader: **Miran Mozetic**
- One working stay for two scientists at SOLFACE from 16/10 to 27/10/2005: Miran Mozetic, Alenka Vesel.

- **28.NANOMAT Nanomaterials for coating: elaboration by splat-cooling in a solar furnace and ball-milling**

- **AGH University of Science and Technology, Faculty of Metallurgy and Materials Science**, Krakow, Poland:
- Project leader: **Jan Kusinski**,
- Scientific field: **Material Science**
- One working stay for two scientists at SOLFACE from 10/10 to 21/10/2004: Slowomir Kac and Jonasz Cienek
- One working stay for one scientist at SOLFACE from 7/03 to 13/03/2005: Dr. Jan Kusinski

- **29.MAGNANOS Elaboration, characterization and magnetic properties of Co and Mn doped ZnO nanophases**

- **Instituto de Ciencia de Materiales de Barcelona (ICMAB-CSIC), Department of Magnetic and Superconducting Materials**, Bellaterra, España
- Project Leader: **Benjamín Martínez**
- Scientific field: **Material Science**
- One Working stay for two scientists at SOLFACE from 4/10 to 7/10/2004: Benjamin Martinez and Lluís Balcells

- **30.OPTONANOS Elaboration, characterization and opto-electronic properties of ZnO based nanoceramics institute of Non Ferrous and Rare Metals**

- **Department of Nanostructured Materials**, Iifov, Romania
- Project Leader: **Radu Robert Piticescu**
- Scientific field: **Material Science**
- One Working stay for three scientists at SOLFACE from 25/10 to 11/11/2004: Radu Robert Piticescu, Adrian Motoc and Tomasz Strachowski

- **31.SHS Sharp hot structures**

- **Italian Aerospace Research Center, Advanced Materials and Manufacturing Technology**, Capua, Italia
 - Project Leader: **Stefania Cantoni**
 - Scientific field: **Material Science**
 - One Working stay for two scientists at SOLFACE from 1/11 to 13/11/2004: Raffaele Borrelli and Giovanni Cosentino.
- **32.METLAYABS Estimate of the solar absorption factor for metallic layers under the action of a short flash of concentrated solar energy**
- **University of L'Aquila, Dipartimento di Energetica**, L'Aquila, Italia
 - Project Leader: **Filippo de Monte**
 - Scientific field: **Physics**
 - One Working stay at SOLFACE from 6/12 to 9/12/2004: Filippo de Monte.

4. Work performed and results

The related areas of the different projects ranged from basic research to applied technology, with fields as different as nanomaterials synthesis and use, new coatings, re-entry vehicles materials study or high temperature solar production of benign chemical energy carriers (H₂, Syngas, ...). This notably corresponds to two of the seven FP6 priority thematic areas: Area 3 *Nano technologies and nano-sciences*, and Area 6 *Sustainable development, global change and ecosystems*.

Numerous publications were published and presentations made in congresses based on work conducted thanks to SOLFACE in the period 2004-2007. The complete list as of beginning 2008 is to be found below.

List of Publications and communications

1. FERRIERE A., RODRIGUEZ G.P., SOBRINO J.A. : *Flux distribution delivered by a Fresnel lens used for concentrating solar energy* , ASME Journal of Solar Energy Engineering, 126, pp.654-660, 2004
2. SANCHEZ BAUTISTA C., RODRIGUEZ G.P., FERRIERE A., VAZQUEZ A.J. *Evaluacion del comportamiento frente a al corrosion de recubrimientos de acero inoxidable procesados en un horno solar*, VIII Congreso Nacional de Materiales, Valencia, 15-17 june 2004
3. MILLERS D., GRIGORJEVA L., LOJKOWSKI W., *Luminescence of ZnO nanopowders*. Radiation Measurements, v.38, p.589, 2004.
4. MILLERS D., GRIGORJEVA L., LOJKOWSKI W., OPALINSKA A. *Luminescence of ZrO₂ nanocrystals*. Solid State Phenomena, vol.106, p.103-107, 2005.
5. SMITS K., *Luminescence of pure and doped ZrO₂ nanocrystals*. International student conference on Developing in Optics and Photonics, DOP-2005, 30 April-1 May, Riga, Latvia, 2005 .

6. D.MILLERS, L.GRIGORJEVA, K.SMITS, W.LOJKOWSKI, A.OPALINSKA, *Yttria stabilized zirconia nanocrystals luminescence*, European Material Research Society Fall Meeting (E-MRS 2005), Book of abstracts, p.229, 5-7 September, 2005, Warsaw. Poland
7. L.GRIGORJEVA, D.MILLERS, A.KUZMIN, R.KALENDAREV, W.LOJKOWSKI, A.TOMASZEWSKA-GRZEDA. *Time-resolved luminescence of nanostructured ZnO*. Ibid, p.229 European Material Research Society Fall Meeting (E-MRS 2005) September, 2005, Warsaw. Poland
8. L.GRIGORJEVA. *ZnO properties and investigations* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
9. A.KUZMIN. *Structural and spectromicroscopic studies of zinc oxide* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
10. D.MILLERS, K.SMITS. *ZrO₂ luminescence* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
11. A.KALINKO. *Photoluminescence of ZnO:Al powders* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
12. CLAUDE MONTY, ADRIAN MOTOC, JULES KOUAM, ROXANA M.PITICESCU, RADU R. PITICESCU, FRANÇOIS SIBIEUDE, TOUNSIA AIT-AHCENE, *Nanocrystalline powders : synthesis, characterisation and applications* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
13. RADU R. PITICESCU, ROXANA M. PITICESCU, ADRIAN MOTOC, MADALINA POPESCU *Hydrothermal synthesis of nanomaterials : from basic to applied research* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
14. K.SMITS, D.MILLERS, L.GRIGORJEVA *Luminescence of ZrO₂ nanocrystals* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
15. JANUSZ D.FIDELUS, DONATS MILLERS, WITOLD LOJKOWSKI, LARISA GRIGORJEVA *Zirconia based nanomaterials for optical oxygen sensors* ECO-NET 2006 Workshop "Nanocrystalline powders: synthesis, characterizations and applications" Institute of Solid State Physics, Riga 27-28, February, 2006, Latvia
16. FERRIERE A., SANCHEZ BAUTISTA C., RODRIGUEZ G.P., VAZQUEZ A.J., *Corrosion resistance of stainless steel coatings elaborated by solar cladding process*, *J. of Solar Energy Engineering*, 80, pp. 1338-1343, 2006
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20. L.GRIGORJEVA, D.MILLERS, A.KALINKO, W.ŁOJKOWSKI, C.J.MONTY, J.GRABIS, R.PITICESCU. *Defect and donor-acceptor luminescence in nanostructured zinc oxide* International Conference Defects in Insulating materials (EURODIM-2006), July 10-14, 2006, Milano, Italy
21. RODRIGUEZ G.P., FERRIERE A., VAZQUEZ A., SANCHEZ M., *Stainless steel cladding onto medium steel by highly concentrated solar energy*, *Surface and Coating Technology*, accepted for publication in 2007.
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47. LARISA GRIGORJEVA, DONATS MILLERS, KRISHJANIS SMITS, CLAUDE MONTY, JULES KOUAM, LASSAD EL MIR. *The luminescence properties of ZnO :Al nanopowders obtained by sol-gel, plasma and vapourisation-condensation methods*, Solid State Phenomena, Vol. 128, (2007), 135-140.
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5. Impact of the project on the European scientific community

In the area of concentrating solar technology and its applications — power and heat generation, production of chemical commodities or energy carriers, material treatment... — no single European country has the capacity to completely develop original research, new processes and new products.

The access offered during this contract helped enormously to disseminate across Europe the knowledge about what we call the '*solar option or solar alternative*', spreading the use of high flux solar applications, for example for:

- materials research,
- synthesis of high tech chemicals,
- cycles for energy storage,
- production of environmentally benign chemical energy carriers,
- knowledge-base behaviour materials under extreme conditions,

SOLFACE contributed to the creation of the European Research Area by the following actions:

- opening the facilities to scientists from Europe and extended Europe to improve the scientific cooperation between researchers,
- improving the development of scientific critical mass in domains where the knowledge is widely dispersed,
- generating strong projects at the European scale to increase their competitiveness and open new research horizons.

Among concrete examples one can quote that several ambitious projects on a European scale were proposed within the FP7 program: SOLFACE thus acted as a catalyst for the high flux, high temperature solar-based scientific fields.

SOLFACE also contributed to strengthen knowledge in more or less unexplored scientific domains by allowing innovative work from new users with the concentrated solar clean energy such as the solar pumped laser technology or high performance coatings to increase material lifetime.