



Optimization of Si solar cells, plastic materials and technologies for the development of more efficient concentRatION photovoltaic systems



INTEGRA Renewable Energies Srl (INTEGRARE) is a company with the main objective to study, develop and market solutions based on renewable energies both for the Italian and the international market. The mission is develop innovative products, by availing oneself of the contribution of dedicated Research Centres. In the field of renewable energies, IntegraRE collaborates periodically with Centro Ricerche FIAT, Centro Ricerche Plast-optica and Elettrosanio. INTEGRARE is part of a Industry Consortium with specific knowledge in the different energy solution (thermal, PV, Thermodynamics, etc). The Consortium has many reference in the different field of Renewable Energies both in Public and Private structure.

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CENTRO RICERCHE PLAST-OPTICA

CRP was established in June 2002, thanks to the joint efforts of CRF (Fiat Research Centre), ALRLI (Automotive Lighting Rear Lamps Italia) and Agemont with the aim to promote research activity and increase knowledge in the field of:

- optics, lighting and communication devices,
- moulding of plastic materials and related technologies,
- micro and nano technologies.

The Mission of the society is to provide innovation, services and consulting to SMEs in order to promote their competitiveness and transfer to them developed innovation. The industrial research activity of CRP is aimed at providing the customer with 3 types of results: innovative products, innovative manufacturing processes and new methodologies.

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The company was established in 1994 by group of solar energy professionals with long term engineering skill. The main activity of the company is Research, development and production of solar trackers and concentrators. Poulek Solar produce and deliver in particular the solar energy collector stands, and these both in the stationary and mobile implementations with the automatic Sun tracking movement in the sky and thus turning the solar energy collectors stands perpendicularly to the direction of the solar radiation all day long. The first Solar Tracker was designed by Ing. Poulek in 1981. Poulek Solar also deliver complete photovoltaic solar systems fitted with photovoltaic panels based on the customer's request. Currently our clients are to be found mostly from the countries of southern Europe and eastern Asia.

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Within the CNR-INFN Natl. Lab. is active the LILIT group whose activity is devoted to the micro and nano fabrication. The facilities are pivoted around the beam line of X-ray lithography and Dual Beam lithography system. The instrumentation set-up is completed by an imprinting stage, a sputtering and two reactive ion etching machines, a metal evaporator a PECVD and electroplating hood and the minor equipment for nanofabrication process and metrology. The all facility is accommodated in three clean room for a total of 200 m² of controlled area. The laboratory works as facility in the frame work of ELETTRA Synchrotron system. Since the beginning of the activities dating 1999, the LILIT group has accumulated a data bank of nanofabrication processes developing in particular multi techniques 3D lithography applied on functionalized materials. Specific fields of interests are nano-optics and photonics.

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MET is owner of cost-effective next generation manufacturing technology for photovoltaic (PV) cells, based on highly innovative concept – self-formation. The fundamental principle of self-formation, having much in common with grow processes found in living nature, is generation of structural growth processes through interaction of chaotic and structured media by applying smart cellular automata software, based on topological approximation of the self-increasing complexity of artificial systems. Application of self-formation manufacturing concept enables manufacturing cost reductions.

MET also has an expertise in materials for fiber optics elements. Specialty Optical Fiber Preforms made of highly pure silica glass with fluorine-doped silica cladding are used for fiber optics manufacturing. All products are extra-fine quality and conform with the highest industry standards.

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The PV Technology Group, is part of the Department of Electrical and Computer Engineering at the University of Cyprus. One of the main priorities of the Department is to develop a research portfolio into the area of renewable energy sources with emphasis on solar and PV systems. The PV Technology group has just completed the installation of the first Photovoltaics Park of its kind at the University of Cyprus, in collaboration with the Institute of Physical Electronics, University of Stuttgart, Germany. The park aims at characterising the performance of PV systems under real field conditions. The PV park currently consists of 15 different grid-connected PV technologies (1kWp each one). We are looking to conduct high quality research in the area of PV systems and to be actively involved in EU initiatives that will enable us to contribute on the EU scene but to also achieve transfer of knowledge to our country in a field of utmost importance for the future of our energy mix in Cyprus.

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The MAIN OBJECTIVE of the project is the **optimization of materials and technologies involved in Concentration PhotoVoltaic System production** in order to reduce the systems' cost/watt and increase the system efficiency.

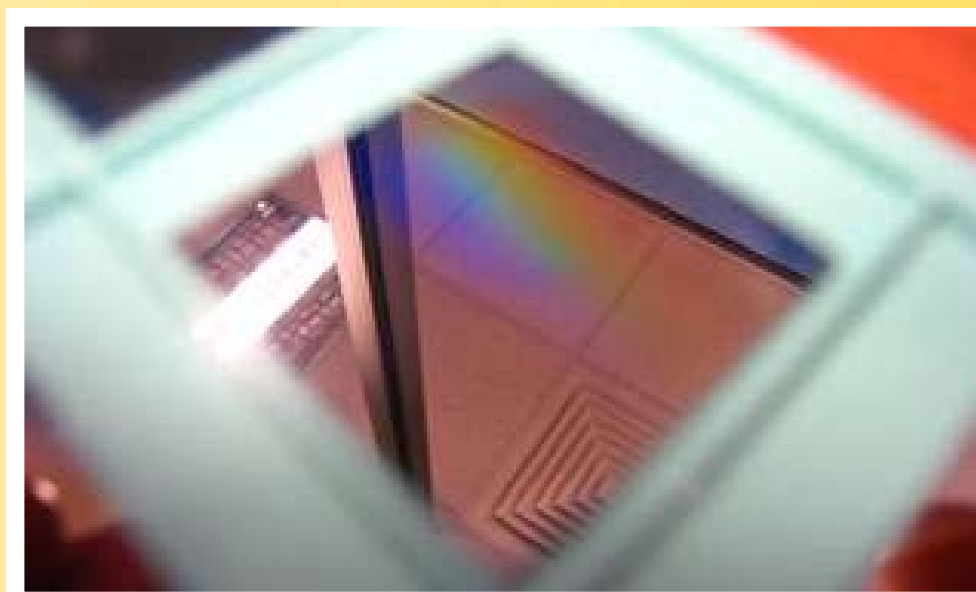
1. The **reduction of system cost/watt**, that reflects in a reduction of the PV-generated electricity, will be achieved by:

- ✗ developing an all-plastic system by using recycled plastic compounds;
- ✗ developing Si solar cells for automatic assembling technology;
- ✗ implementing and industrializing automated high-throughput technologies for cell assembly and optics production.

2. The **increase of system efficiency** will be achieved by:

- ✗ increasing Si concentration cell efficiency by using surface plasmonic crystal structures;
- ✗ developing plastic materials doped with down-converting nanoparticles for modification of the solar spectrum in order to enhance the absorption efficiency of cells.

SCIENTIFIC OBJECTIVES



Optimization of silicon concentrator solar cells

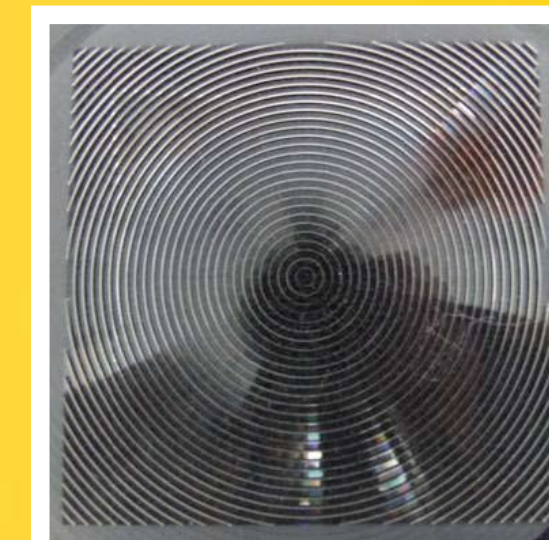
- ✗ surface plasmonic crystals on the scale of the light wavelength for the improvement of solar cell light absorption
- ✗ hybrid approach of laser grooved and planar contact areas for realization of Si cell suitable for interconnection with automated ultrasonic welding



Development of new application-addressed nanocomposite thermoplastic material

- ✗ transparent plastic material doped with nano-structured down-converter elements for the realization of optical elements for modification of the solar spectrum in order to enhance the efficiency of solar cells
- ✗ nanocomposite plastic material from recycled one, with thermal and mechanical properties suitable for realization of housing and reflectors

TECHNOLOGICAL OBJECTIVES



Implementation and industrialization of automated low-cost technologies for CPV components fabrications:

- ✗ automated high-throughput techniques for solar cell assembling: pick&place technique and ultrasonic welding;
- ✗ plastic moulding technology: vacuum and injection-compression modes for the realization of high quality lens

EXPLOITATION OF RESULTS



The scientific and technological objectives of the project will be exploited by the **realization of a low concentration photovoltaic system** based on the point-focus idea. The new system, ready to be produced at the end of the project, will be based on **Silicon concentration solar cell technology coupled to hybrid mirror-lens concentrator optical system**, designed in the framework of the project. The project also includes the design and development of an **innovative one-axis tracker integrated with optics** for the realization of a compact CPV module to be used for rooftop applications.

Production of 1 KWatt of CPV system for testing



Seventh Research Framework Programme



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