



Eco-sustainable Food Packaging Based on Polymer Nanomaterials

COST Action FA0904

Start date: 29/03/2010

End date: 28/03/2014

Year: 1

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Chair

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Scientific context and objectives (1/2)

Background

- Polymer Nanotechnology and Food Packaging;
- How to treating the demanding needs of the users (*health, taste environment*), the specific requirements of the food industry and the cost.

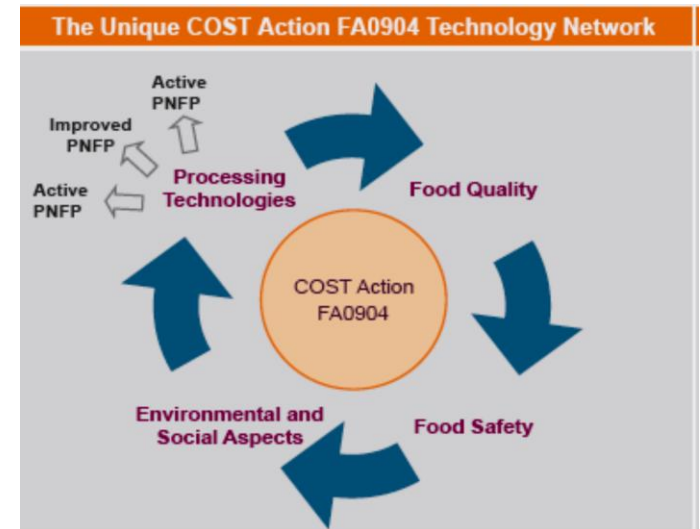
MoU Objectives

- To constitute an international scientific and technology network on issues related to eco-sustainable Polymer Nanocomposites Food Packaging (PNFP) for the preservation, conservation and distribution of high quality and safe food
- To contribute to identify the barriers (*in research and technology, safety, standardisation, trained workforce and dissemination*) that prevent a complete successful development of PNFP and the strategies to proceed further.

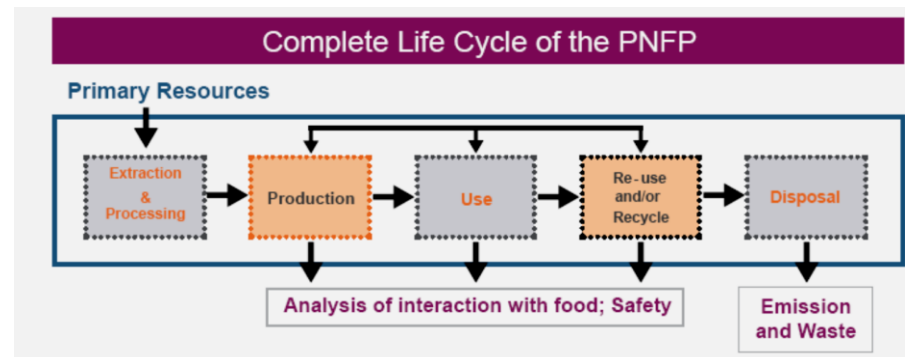
Scientific context and objectives (2/2)

Research directions

Approach and methodology →



Unique contribution *To look at the complete life cycle of the PNFP by the combined efforts of leading research/industrial groups*



Working groups

- **WG1 Development of new safe PNFP**
Leader: Dr Mika VAHA-NISSI (FI) - VTT
Vice-leaders: Prof. Alex SIVAN (IL) and Dr Janis ZICANS (LV)
Approximate number of members: 45
- **WG2 Development of new processing technologies including modelling and simulation**
Leader: Prof. Jose Maria LAGARON CABELLO (ES)
Vice-leaders: Dr Ramune RUTKAITE (LT) and Dr Jeannette DEXPERT-GHYS (FR)
Approximate number of members: 45
- **WG3 Development of new strategies to identify any critical interaction of PNFP with food**
Leader: Dr Qasim CHAUDHRY (UK) –
Vice-leaders: Dr Ignacy JAKUBOWICZ (SE) and Dr Ramesh Babu P (IE)
Approximate number of members: 30
- **WG4 Ethics, Standardization, Science-society dialog**
Leader: Prof. Geoffrey HUNT (UK) –
Vice-leaders: Prof. Marek KOZLOWSKI (PO) and Dr Ruth Schmid (NO) –
Approximate number of members: 30

First meeting of the WGs (Iasi, Romania, June 2010): the WG leaders presented the context of the activities and an agreement on the major themes/division of tasks was reached

Action Parties

Grant Holder

ICTP/CNR- Italy

Scientific Representative

Dr. Sossio Cimmino

Participating countries

COST Countries

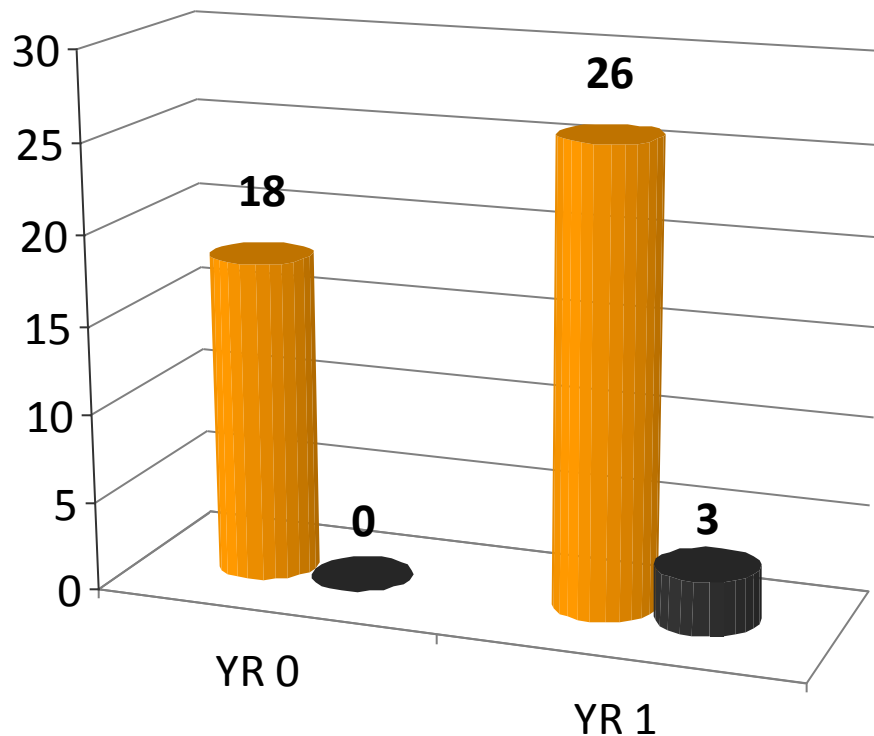
AT, BE, BG, CH, CZ, DE, DK, ES, FI, FR, GR, IE, IL, IS, IT, LT, LV, MK, NL, NO, PL, RO, RS, SI, SE, UK.

Non COST Countries

USA, CA, NZ (pending)

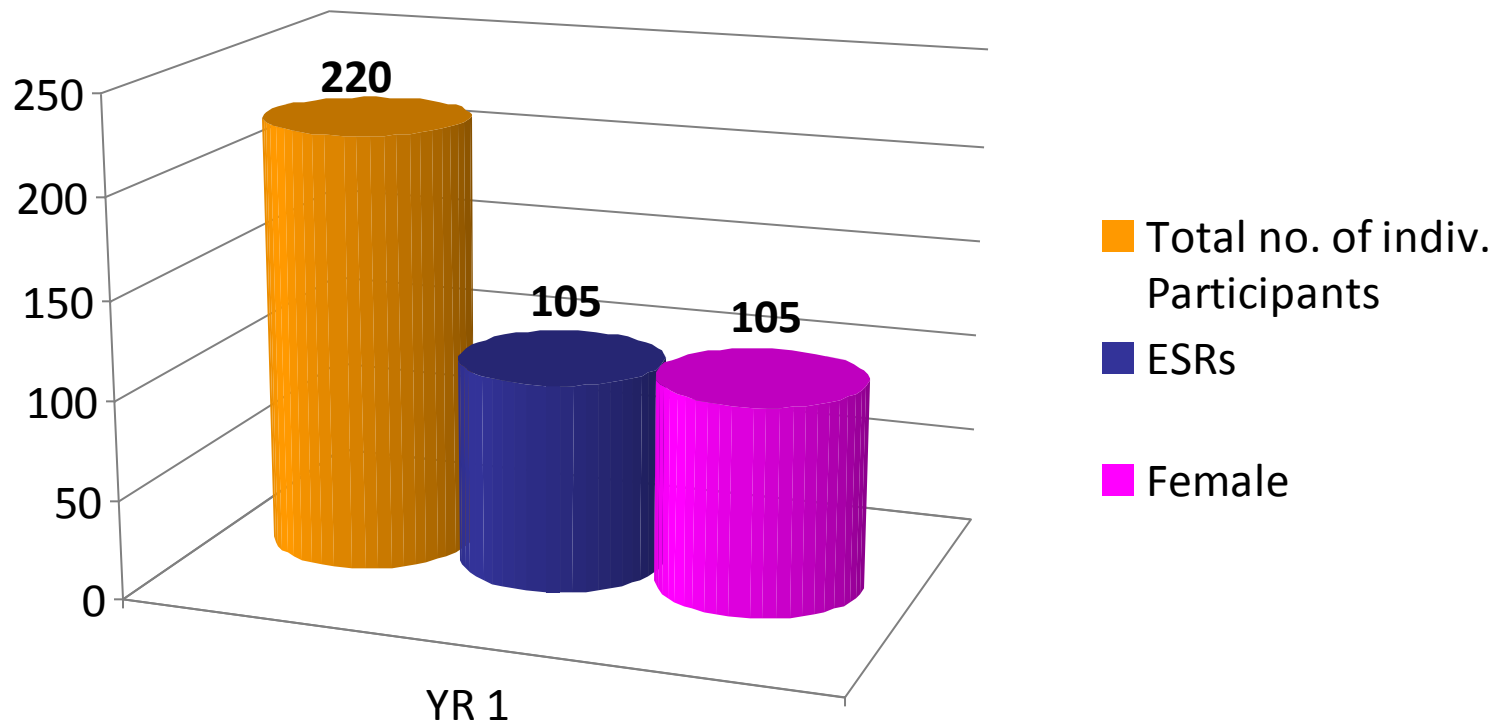
Interested Countries:

TR (pending), PT



■ Parties ■ Non-COST Countries

Action participants



Use of COST Instruments

| Activity (No.) | Year 1 |
|--------------------------|--------|
| MC/WG Meetings | 2/5 |
| STSMs | 7 |
| Training Schools | - |
| Workshops or Conferences | 3 |
| Joint Publications | 20 |

Progress includes several successful activities:

- Kick-off meeting (Brussels 29-30 /3/2010), where procedures and / tools to guarantee the Action development were set;
- Plenary conference (Iasi , Romania 29/30-6-2010), that included the 1° WGs meeting and a Round Table dedicated to industry;
- Technological Seminar London (1/2 -9-2010) on Ethical Issues.
- International Workshop (Pozzuoli Italy 3/4-3-2011) with a session dedicated to WG1, MC meeting and a Round Table for ESRs.
- Involvement of ESRs: 7 STSMs grants, organization of a round table, constitution of an intergroup Entity.

Results vs. Objectives

The focus of the activities performed was mainly to build, to strengthen and to enlarge the Network and to plant the seeds for *innovative knowledge in the field of PNFP*

The Action has fully achieved the objectives and technical goals for this first period, with results well above those planned

Tab 1: Scientific objectives of COST FA0904 in the 1st year: Planned and Realized results

| Scientific objective | 1st year/ Planned | 1st year/ Realized |
|-------------------------------|-------------------|--------------------|
| Networking partners | 70 (23 countries) | 80 (26) countries- |
| Joint projects initiated | 4 | 9 |
| No. of STSM | 5 | 7 |
| No. of industry participation | 13 | 20 |
| Joint publications | 10 | 20 |

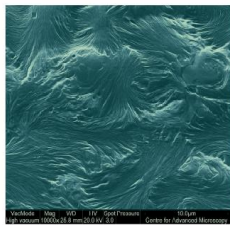
Innovative networking (1/3)

Innovative knowledge resulting from COST networking through the Action

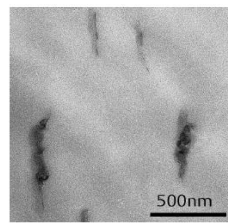
In the short time of life some interesting results were already obtained, mainly through the STSMs, with formation of new networks:

- the investigation of the morphological/structural properties (identification of the degree of dispersion of nanoparticles in the matrix and their influence on properties,
- the study of recyclability of some PNFP for increase ecosustainability,
- the new approach for setting up novel nanosensors to measure temperature and humidity based on fibre optic sensor,
- the identification through designed and implemented equipment (scattering techniques and SEM, TEM, AFM) of the shape and minimum amount of nanoparticles required to influence properties and processing conditions for nanomaterials with nano-platelets or spherical nanoparticles.

a)



b)



Improved packaging: Films of polypropylene (a) and polypropylene with embedded clay nanoparticles (dark objects) b), used for food production

Innovative networking (2/3)

Significant highlights in Science

➤ The analysis of dispersion and alignment of rod-like and sheet-like nanoparticles, using in-situ time-resolving x-ray. The flakes align parallel to the flow direction (A) and orthogonal to the velocity gradient (B), resulting in a flakes alignment parallel to film surface, exactly the arrangement required to increase the tortuosity of gas paths, which provides higher barrier properties. **This activity resulted also in a formation of a new network**

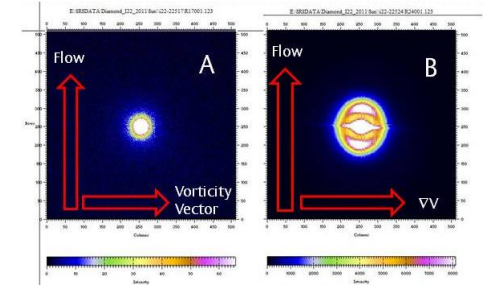
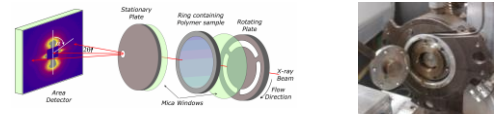


Figure SAXS patterns obtained for a sample of polymer films containing 0.5% wt graphene flakes (12nm thickness), for two shear flow geometries as shown in the figures and obtained using (A) a parallel plate shear cell and (B) a miniature Couette cell as shown below.

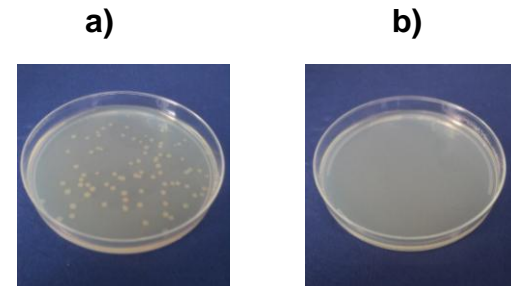


SAXS patterns for a polymer films with 0.5% wt flakes for (A) parallel plate shear cell, (B) a miniature Couette cell.

Significant scientific breakthrough

The development of a new film based on isotactic polypropylene and zinc oxide that shows antibacterial activity against Escherichia-coli. This significant scientific breakthroughs, still in a preliminary stage was obtained with a multidisciplinary approach from networking of 8 institutions of 4 countries; **This activity resulted also in a bilateral project CNR/CNRS/ and formation of new network**

Active packaging: Antibacterial effect of ZnO in iPP films
a) Control plate; b) iPP/ZnO 5%



Innovative networking (3/3)

•Tangible medium term socio-economic impacts achieved

➤The networking among participants has already stimulate participants to submit joint projects. **At the moment 10 proposals were approved and obtained financial support**

➤The Conference “Ecosustainable food packaging based on polymer nanomaterials”, Iasi, Romania, 28-29 June 2010” with a **Round Table dedicated to the Industry**

International Workshop

“Safe Nanostructured Polymer Materials: characterization and new processing technologies”

Pozzuoli (Naples) Italy
3rd-4th March 2011

Under the auspices of
FP7 Project NaPolyNet:
Setting up research-intensive clusters across the EU on characterization of polymer nanostructures

Cost Action FA0904:
Eco-sustainable Food Packaging based on Polymer Nanomaterials

Programme and extended Abstract

with industrial representatives that pointed out their view

Funded proposals

| | |
|---|---|
| AGREEMENT CNR/BAS JOINT PROJECT 2010-2012 | An integrated approach to designing polymer nanocomposites with layered silicates and carbon nanotubes |
| Proposal n° 20101056 “Soleil Parigi France | Crystallisation behaviour of novel polymer nanocomposites for safe food packaging “Geoff Mitchell |
| ACCORD CNR/CNRS PROJECTS CONJOINTS DERESERCHE 2010-2011 | Nanocompositi antibatterici a matrice poliolefinica per l’imballaggio Alimentare |
| Project within the frame of the programme Nanotechnologies for Society supported by Academy of Science of the Czech Republic 010_2011 | ”Nanocomposite films and nanoparticles prepared in low pressure plasma for surface modifications |
| Proposal n° 20100458 for Elettra TRIESTE | “Shear-Induced Isothermal Crystallization of Isotactic Polypropylene (iPP) based Nanocomposites with Montmorillonite (MMT)” |
| Consortium Emilia-Romagna Region, Universities, Chamber of Commerce and industrial association, CNR and ENEA, | ASTER |
| Proposal n 23868 “proposer Geoff Mitchell – ESRF Grenoble | Controlling the morphology of polyethylene through low molar mass additives” |
| Project for Elettra beam time n. 2010/5480 | Crystallization behaviour of novel polymer nanocomposites for food packaging applications |
| Project within the frame of the programme Nanotechnologies for Society supported by Tukitak Turkey 2011-2012 | Novel polymeric films for food packaging application |

Inter-disciplinary networking

Level of inter-disciplinarity, its benefits and impacts

The promotion of the cooperation with other existing platforms on polymer nanotechnology and standardization bodies was one of the main activities:

Synergies with 20 European networks was established:

to mention the synergy with FP7 project NapolyNET and Cost Action MP0107

Joint events were organized to attract scientists from different disciplines and to stimulate new inter/multidisciplinary initiatives.



The level of inter-disciplinarity was elevated: an example of the additional knowledge generated by interdisciplinary networking was already mentioned with the significant scientific breakthroughs,

FP7 NAPOLYNET
"Setting up research-intensive clusters across the EU on characterization of polymer nanostructures"
and
COST ACTION FA0904
"Eco-sustainable Food Packaging based on Polymer Nanomaterials"
Technological Seminar

POLYMER NANOMATERIALS FOR FOOD PACKAGING
Characterization Needs, Safety and Environmental Issues
1st-2nd September 2010
LONDON
at The Lensbury Conference Centre, Teddington
Hosted by St Mary's University College, London

New networking

- **The number of participants and countries has been constantly growing over the year**
At the moment Turkey and New Zealand (RA Country) are asking to participate, and Portugal is showing its interest.

| Individual participants | ESR No- % | Female Nn - % | No COST Countries |
|-------------------------|-----------|---------------|-------------------|
| 220 | 105 - 45% | 105 – 45% | 3 |

Involvement of ESRs

- almost 105 young researchers (through the STSM, project activities) coming also from outside the participants institutions
- number of STSMs granted (7) higher than that planned;
- organization of a successful Round Table dedicated to young researchers “Making the Science of future in PNFP”
- invitation to all the STSM grantees to present the result of their stage at the international workshop;

The number of ESRs involved in the Action Activities already high is expected to increase in the next period as a training school is planned in November 2011 in Skopje

New networking

Advancement, promotion, and dissemination of scientific knowledge through publications (by Action members that resulted from COST networking through the Action) and other outreach activities

The number of publications in peer reviewed journals is at the moment 20

Several activities were performed concerning the dissemination : to mention

- Creation and maintenance of the project WEB site at www.ictp.cnr.it/index.php?option=com_content&view=article&id=108&Itemid=104 ;
- Preparation of a poster presented at several meeting ;
- Presentation upon invitation of Action objectives/activities at several meetings and workshops;

The submission of proposals generated in conjunction with the COST action has already secured some research funding already showing the high capacity of the Action members to raise research funds that it is expected will be confirmed in the next periods

Working Groups Progresses

First meeting of the WGs (Iasi, Romania, June 2010): the WG leaders presented the context of the activities and an agreement on the major themes/division of tasks was reached.

Innovative knowledge resulted mainly through the STSMs that took place with topics related to WGs on basic and applicative science in PNFP (already shown)

WG1/WG2

- **A workshop (WP2) was organized in March 2011 in Naples with new personalities joining to present their views;**

- **A mapping of the research/industrial Institutions interested in WG1/WG2 with their main competence/expertise is in preparation;**

- **The initial steps for organization of workshops in Finland (WG 1- Sept 2011) and in Spain (WG1/WG2- March 2012) were taken.**

- **Plan for the future includes presentation of demonstrator projects, to go beyond the materials development/processing/characterization and to evaluate food shelf-life, biodegradability.**

WG3/WG4

- **Organization of a Technological Seminar (London Sept. 2010) on: Characterization Needs, Safety and Environmental Issues of PNFP;**

- **WG3 distinguished between two domains of communication within its remit: 1) intra-technology communications between different fields of science, and 2) Extra-technology communication between the scientists and other relevant parties such as industry, consumers, NGOs, regulators, policy-makers and insurance companies;**

- **Plan for the future includes a seminar (late in 2012) on migration, food impact and food quality (WG3) and the preparation of a booklet for consumers that explains the development of safe nanomaterials-based (WG4).**

Self evaluation, Strengths and Weaknesses

Strengths: The first year of activity in this Action has been extremely fruitful.

- The full and interested participation of all the COST members: with submission of joints publications/projects.
- The interest of the scientific international European Communities in the field of PNFP:
 - *The high number of networking participants from research, academic and industrial Institutions,*
 - *The active participation of scientists from No COST Countries;*
 - *The selection of the Action aim and results for further dissemination from international scientific magazines;*
 - *The invitation to Chair and MC members to present the Action objectives and activities at international meetings and to edit a book on the Action theme;*
 - *Finally the fact that several delegates attended the Action activities with their own funds.*
- The synergies with other networks/projects: to exchange of best practice, optimize resources, attract scientists from different disciplines, stimulate new inter/multidisciplinary initiatives.
- The high involvement of ESRs
- Excellent balance *in term of female participation and among Senior/ESR researchers (~ 50%).*

Weaknesses: No negative points have arise so far. The most significant problems were the impossibility to accept all the requests for events participation and for STSM due the limited budget available.



COST

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COST Action FA0904

Thank you for your attention

Clara Silvestre Chair

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