Project title:

Mitigation of Risk and Control of Exposure in Nanotechnology based inks and pigments

Project Acronym: **NANOMICEX**

Grant Agreement: **NMP4-SL-2012-280713**

Attachments to the Publishable Summary of the Project

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Nature of the Document Public
PUBLIC

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1. Contact Details and List of Partners

The following table shows the list of participants in the project, type of organization and location:

Table 1. List of Participants

Participants		Contact
Packaging, Transport and logistics research center	ITENE	Carlos Fito Email: cfito@itene.com
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Plasmachem GmbH	PlasmaChem	Alexei Antipov Email:antipov@plasmachem.com
Torrecid, S.A.	TORRECID	Carlos Concepción Email: carlos.concepcion@torrecid.com

The table below includes the directory of the main persons involved in the execution of the project per partner:

Table 2. Directory of people involved in this project.

First Name	Last Name	Affiliation	Address	e-mail
Carlos	Fito	Packaging, Transport and logistics research center	Albert Einstein, 1 CP.46.980 Paterna (Valencia) – Spain	cfito@itene.com
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Gianvito	Caputo			gianvito.caputo@hu-berlin.de
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Carlos	Concepcion			*carlos.concepcion@torrecid.com*
Lorenzo	Calabri	Tec Star , Srl	TEC Star Srl Viale Europa, 40 41011 Campogalliano (MO) - Italy	calabri@tec-star.it
Alberto	Borghi	Tec Star , Srl		borghi@tec-star.it

2. Compendium of Photographs illustration and promoting the work

2.1. WP 1- Characterization of the Engineered Nanoparticles

The following figure shows the electron microscopy micrographs of the nanoparticles studied under the scope of the project

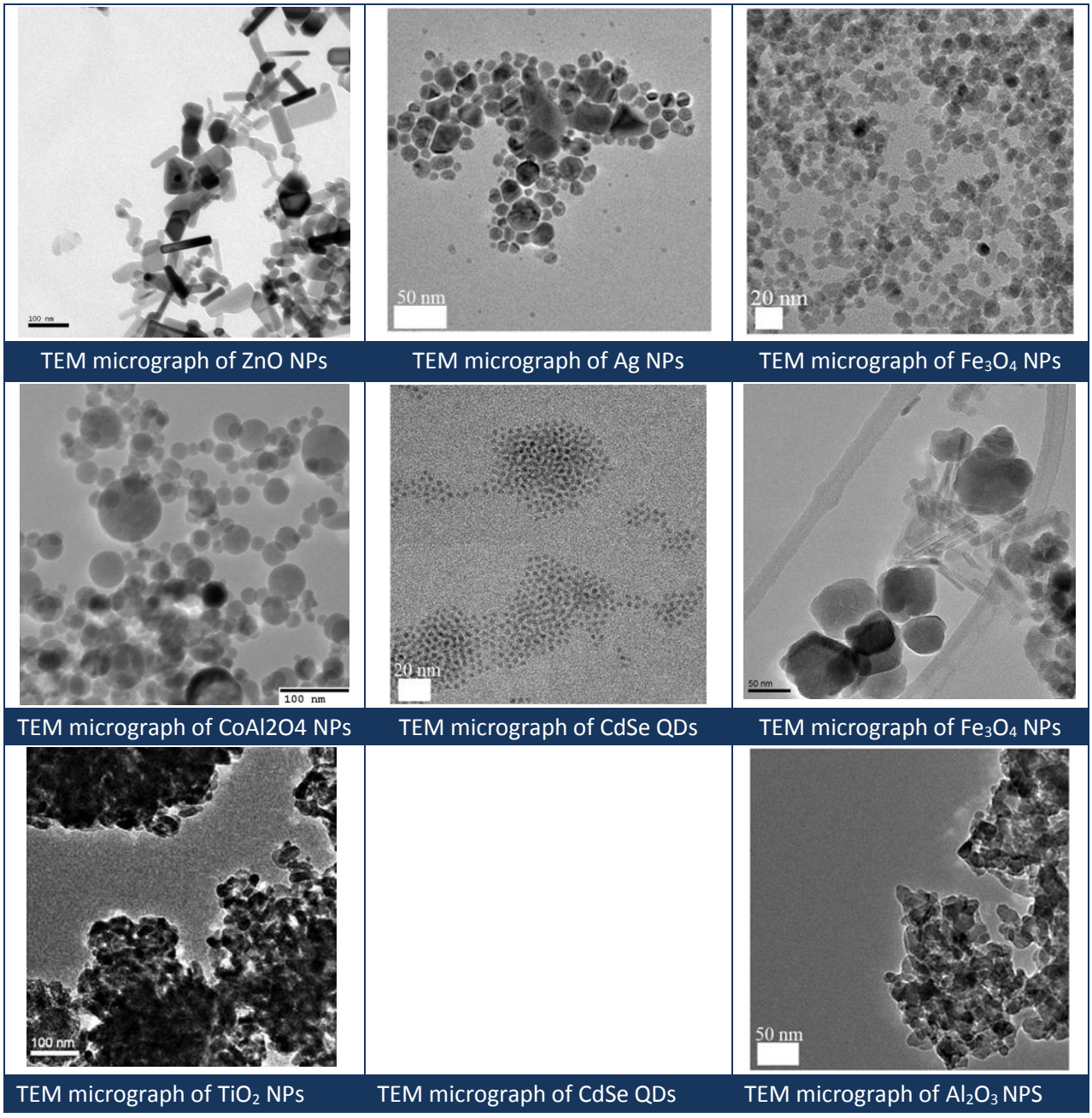


Figure 1. TEM Micrographs of the target Nanoparticles

The following figure shows electron micrographs used for size distribution measurements

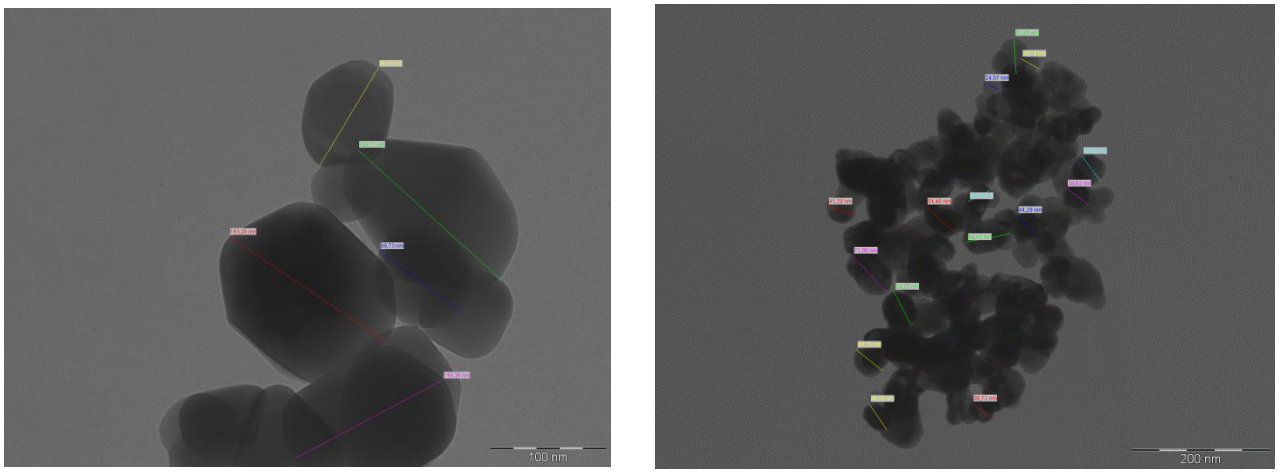


Figure 2. Electron Micrographs for particle size distribution measurements

On the other hand, the table below summarizes the main properties achieved by the use of nanoparticles on the basis of peer reviewed literature.

Table 1. Nanoparticles and related applications

NPs/ Properties	Visible Light absorption	Light-scattering	Anti-bacterial	Scratch Resistance	UV Resistance	Fire Resistant	Anti-corrosive	Self-Cleaning	Conductivity	HT-Photovoltaic	Gloss	Hiding power	Color Strength	Weathering resistance
SiO_2		X	X	X	X	X	X				X			
TiO_2		X	X	X	X	X	X	X				X		X
ZnO		X	X	X	X	X	X	X	X			X		X
Fe_3O4	X								X				X	
Al_2O_3		X		X	X	X					X		X	
Fe_2O_3	X						X						X	
Cr_2O_3	X						X						X	
Ag NPs	X		X						X				X	
Cu_2O	X		X										X	
QDs	X								X	X	X		X	
CoAl2O4		X				X					X	X	X	X
ZrO2		X		X	X	X								X

2.2. WP 2- Development and Selection of functional modified nanoparticles

The following figures show examples related with the surface modifications conducted within WP2

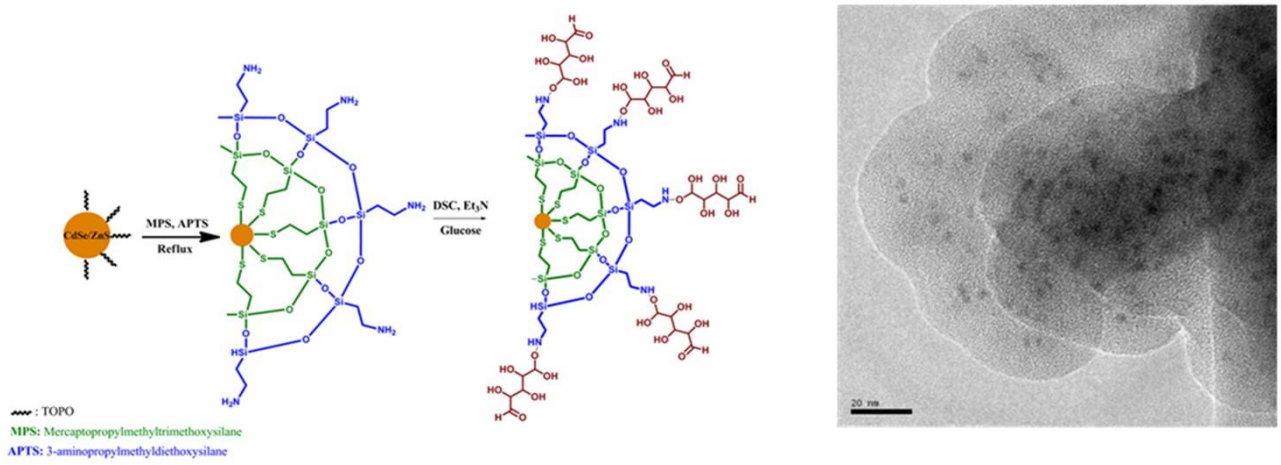


Figure 3a. Schematic diagram of glucose modification silica coated QDs and TEM micrograph of glucose attached QDs on silica coating (QD-Si-Glucose).

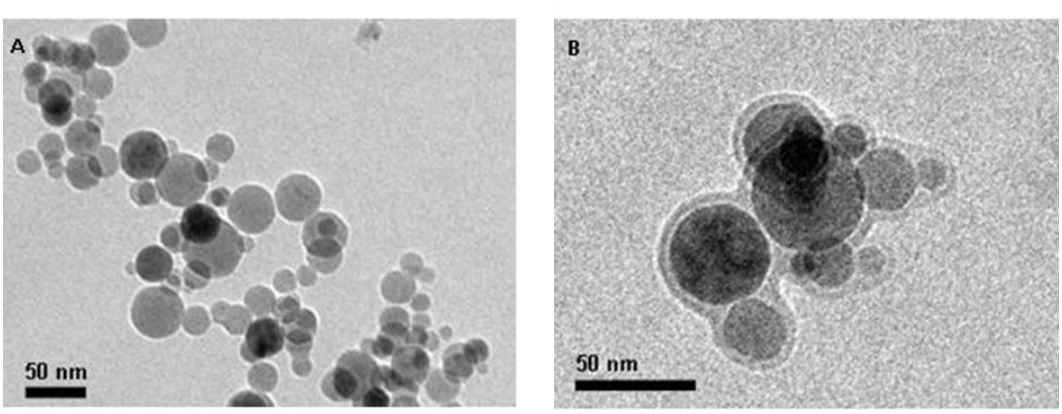


Figure 3b. TEM image of the bare (A) and silica coated (B) CoAl2O4 NPs

On the other hand, the following figures demonstrate the reduction of the toxicity of target NPs after the modification

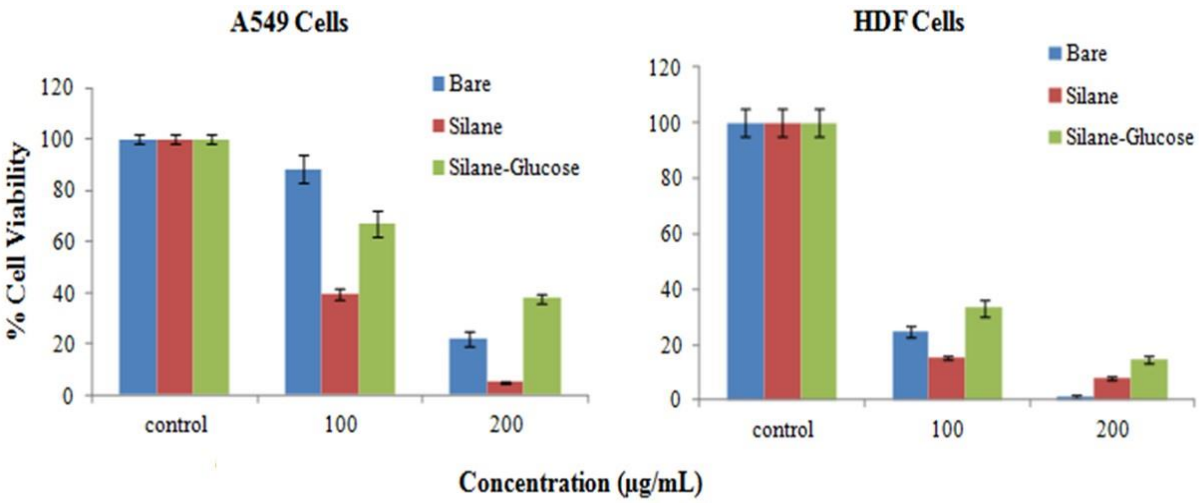


Figure 4. Cytotoxicity assessments of glucose modified QDs NPs in HDF and A549 cells. Figure 4 shows the cytotoxicity comparison of the bare QDs at 100-200 µg/mL concentrations. As seen cell viability results, glucose modification decreased the toxicity of the QDs after silica coating on HDF and A549 cells

2.3. WP 3- Hazard Assessment

Particle	*P. subcapitata*	*D. magna*	*L. variegatus*	*J774*	*A549*	*C3A*
Ag	**1**	**1**	**1**	**5**	**5**	**2**
ZnO	**2**	**2**	**3**	**1**	**2**	**1**
CdSe QDs	**3**	**3**	**2**	**4**	**1**	**3**
$CoAl_2O_4$	4	4	3	2	5	7
Al_2O_3	7	4	3	6	3	5
Fe_2O_3	6	4	3	6	5	4
TiO_2	5	4	3	3	4	5

Table 2.Toxicity ranking for unmodified particles (1 – highest, 7 – lowest ranking)

- **Experimental Set Up for Ecotoxicity Studies**

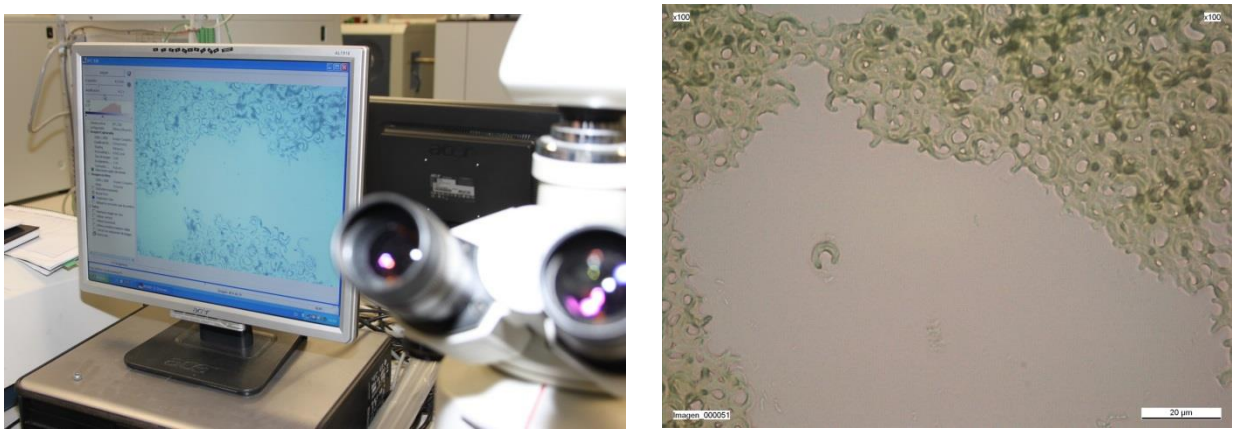
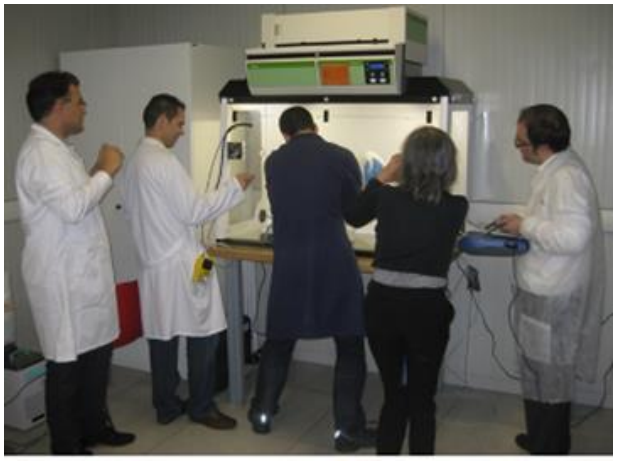


Figure 5. Sample of the freshwater alga *Pseudokirchneriella subcapitata* used for ecotoxicity testing

2.4. WP 4- Exposure Assessment

Figure 6. Real-Time Exposure Measurement Devices use for exposure assessment



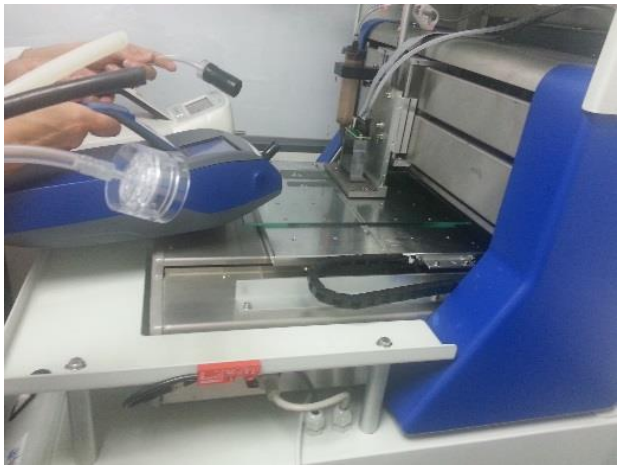
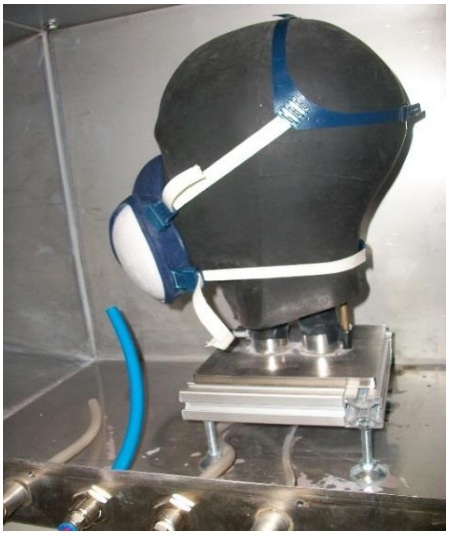


Figure 7. Measurements of airborne NPS during weighting (a) and Ink jet printing operations (b)

2.5. WP 5- Risk Management and Control Measures



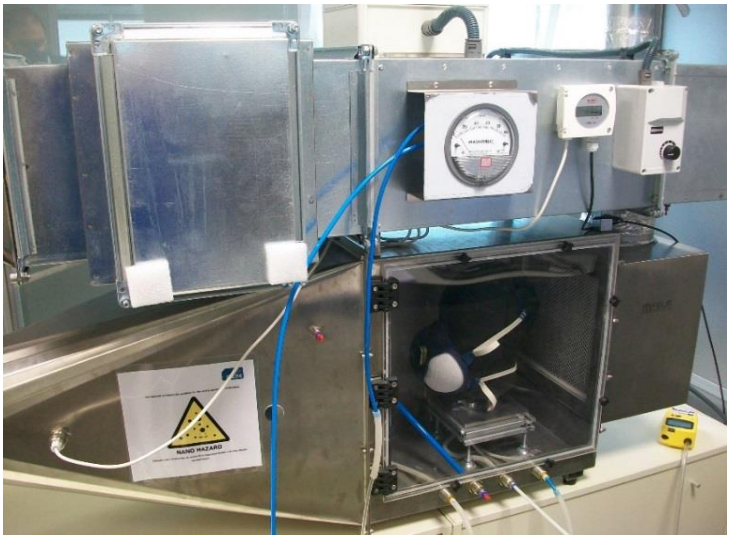


Figure 8. Sheffield head (a) testing chamber (b) used for effectiveness testing

Figure 9. Manikin (a), Sheffield heads (b) and aerosol generator (c) used for effectiveness testing

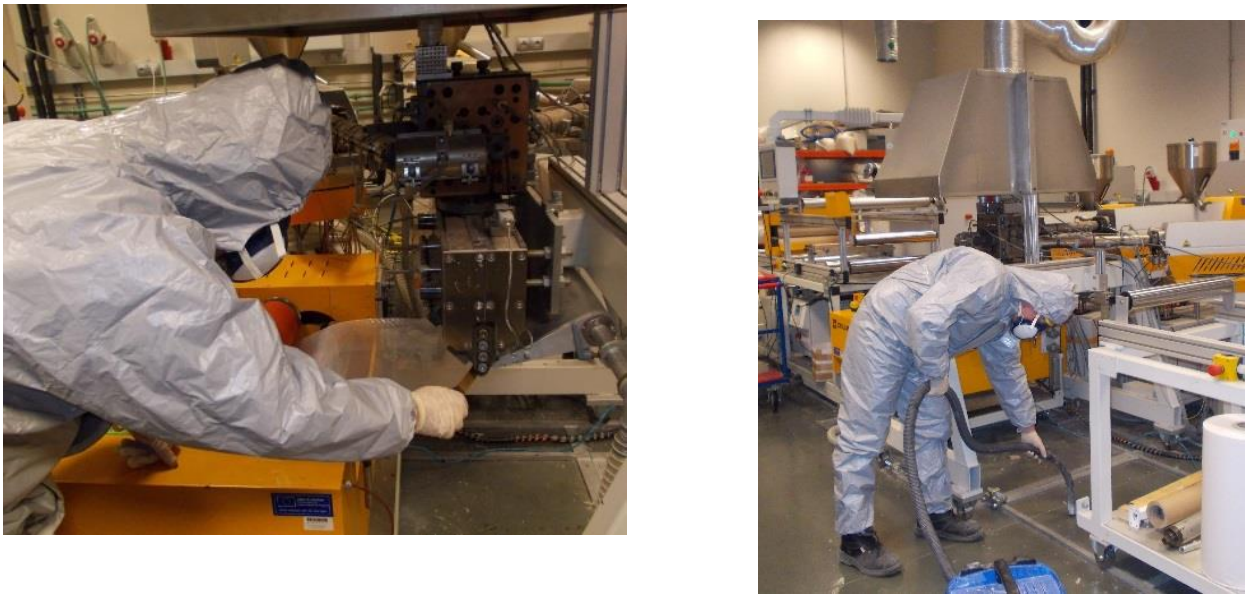


Figure 10.Simulation of cleaning operations – RMM testing

2.6. WP 6- Nano SLCRA

GES CODE	ES	SHORT ES TITTLE	PROCESS OR ACTIVITY	SHORT DESCRIPTION OF PROCESS OR ACTIVITY	Estimated inhalation e(mg/m3) ART TOOL*	DNELs (mg/m3)		RCR (inhalation)	
						Bibli.	Nmicex	Biblio.	Nmicex
GES Ag 1 (Nano Ag synthesis via a growth controlled precipitation reaction)	ES 1	Charging & mixing materials (non-nano precursors and solvents)	CES 1.1. Charging raw materials	Transfer pre-weighed precursor and solvent (including the surface controlling agent/ligand) into reaction vessel (FC)	6,20E-06	0,000098- 0,00033	0,000041- 0,00014	<1	<1
	ES 2	Synthesis reaction & treatment with non-nano surface controlling agent	CES 2.1. Evaporation	Transfer mixture into flask (FC) and secure flask on rotator evaporator (BT)	5,30E-06			<1	<1
				Volume reduction (BT)					
			CES 2.2. Reduction and ligation	Transfer mixture to FC and add reducing agent	3,00E-07			<1	<1
				Reaction goes to completion (FC)					
	ES 3	Isolation of ENM	CES 3.1. Nanoprecipitation and recrystallisation	A miscible (non-solvent for the ENM) solvent is added to the solution. Solvent displacement of the nano-Ag occurs.	9,50E-06			<1	<1
	ES 4	Recovery by centrifugation	CES 4.1. Recovery	The supernatant is removed from the centrifuged product (FC)	4,80E-06			<1	<1
				The product is separated and washed by centrifugation (BT)					
	ES 5 A	Packaging intermediate product (for storage in cabinet)	CES 5.A ENM as wet paste (Packaging intermediate product (for storage in cabinet))	The hydrophobic nano-Ag are weighed into 2-100 ml bottles on an analytical balances (BT)	0,00E+00			<1	<1
	ES 5 B	Drying - Rot. Evaporator	CES 5.B Dry ENM powder (Drying - Rot evaporator)		9,40E-03			>1	>1
	ES 5 C	Milling	CES 5.C Fine ENM powder		4,80E-03			>1	>1
	ES 5 D	Packaging product (for dispatch)	CES 5.D Dry ENM powder (Packaging product (for dispatch))		4,80E-03			>1	>1
	ES 6	Wet cleaning of glassware & fume cupboard cleaning premises	CES 6.1 Cleaning of plant	Oven and mill are washed with a detergent solution and rinsed with water when the product line in changed	2,10E-03			>1	>1
	ES 7		CES 7.1 Cleaning of premises	Floors and fixed surfaces are cleaned as required and after each run.	6,20E-03			>1	>1
	ES 8	Maintenance	CES 8.1 Maintenance	Extract ventilation system on fume cupboard overhauled annually (taking air flow measurements, cleaning conduit, replacing worn mechanical parts and filters)	6,90E-03			>1	>1

Table 3. Summary of risk characterization ratios for the synthesis of nano-Ag (hydrophobic) used in conductive ink-printing substrates using the ART tool

2.7. WP 7- Industrial Case Studies

Figure 11. Application of surface modified QDs . Print-head (middle) can be removed and washed when necessary. Cartridge with QDs ink (right).

2.8. WP 8- Project Coordination and Management

The following photographs were taken during the Kick Off Meeting of the project held in Brussels on April, 2012.

Figure 12. Project Kick Of Meeting

3. Dissemination Activities

3.1. Project Logo

Figure 13. NanoMICEX Logo

3.2. Participation in networking events

Figure 14. Presentation of the project during the NanoSafety Cluster meeting hold in Grenoble from the 29th to 31st of May 2012

Figure 15. NanoMICEX workshop hold in Venice. March 2015

3.3. Other Dissemination Materials

- **Project Web Site – *www.nanomicex.eu***

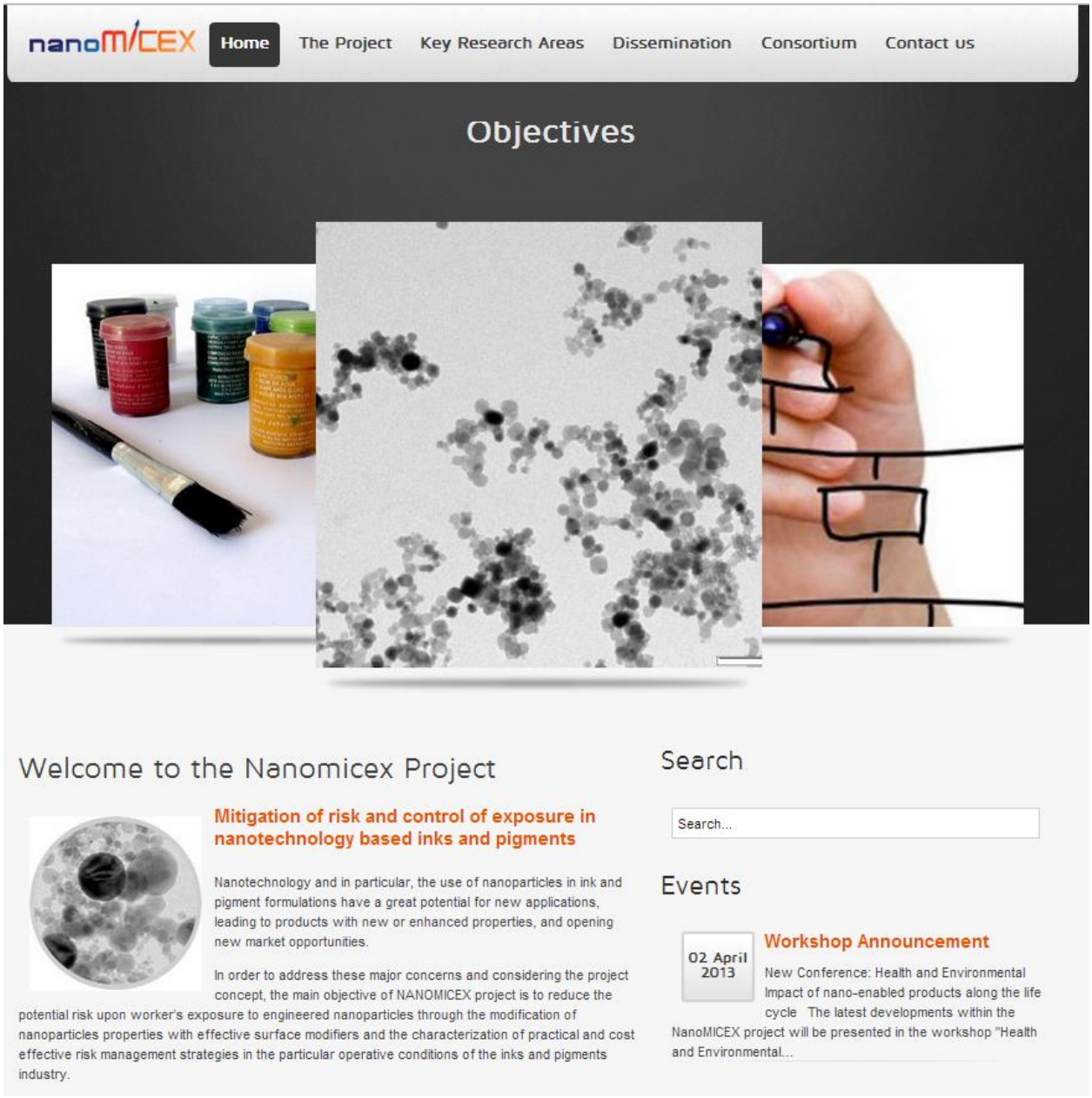


Figure 16. NanoMICEX WebSite screenshot

- **Project Brochure**

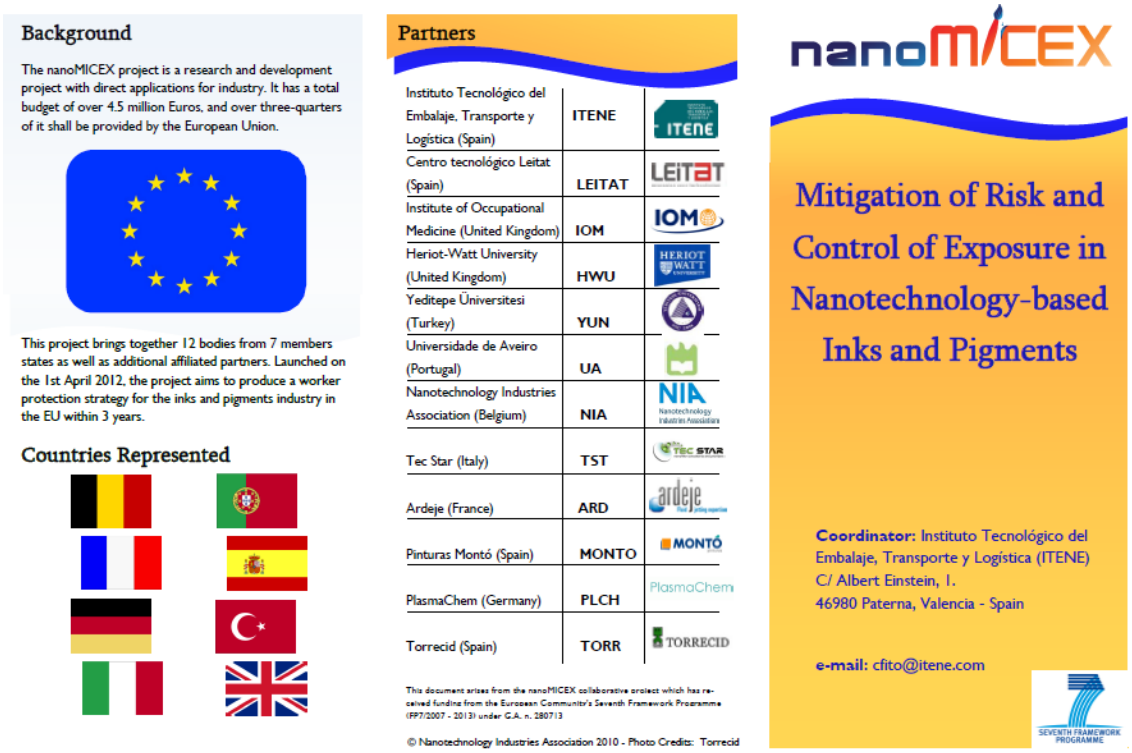


Figure 17. Extract of the Project Brochure

- **Press releases and newsletters**

nanoMICEX Newsletter No. 1
March 2013

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- Humboldt University replaces Aveiro in Project
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- Work done so far
- Delivering $CoAl_2O_4$ spinel Nanopigments
- Tuning the Colour of $CoAlO_4$ by coating with Gold
- Up-scaling of the Synthesis of Nano-silver and CdSe Quantum Dots
- nanoMICEX on the road
- Brochure + Site now available!
- Project Timeline

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Welcome to the first nanoMICEX newsletter!

The nanoMICEX team has been working hard over the past year on improving the conditions for workers in the inks and pigments industry. This newsletter will bring you some of the latest news and developments from the project, showcasing how the project is working toward fulfilling the promises made in its very name: the Mitigation of Risk and Control of Exposure in Nanotechnology-based inks and pigments (nanoMICEX).

This edition begins by reporting on the kick-off meeting in Brussels in March 2012, where project partners met one another officially for the first time and talked through the goals and tasks that lay ahead in the coming years. Comings-and-goings of project staff since that meeting are also detailed.

A brief description of the work that has been done by the project thus far is provided on the third page. More in-depth articles by nanoMICEX partners have been provided,, describing more fully how the partners are ensuring the safety of workers within the industry.

Readers can also look up where the project has been appearing in its inaugural year on page 5, before viewing a timeline to see what's coming for the project in the near future.

We hope that you will enjoy this dispatch from the nanoMICEX project, and look forward to your return to read up on the progress that's been made in the September 2013 issue!

Regards,

the nanoMICEX team

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nanoMICEX

nanoMICEX Kick-Off Meeting held in Brussels

Project partners involved in the nanoMICEX project met for the first time at the Valencian Regional Office in Brussels, Belgium, in March 2012. Coming from 8 different European countries, they discussed the work they were going to do to address the health and environmental consequences associated with the inclusion of nano-additives in the industrial production, use and disposal of paints and inks.

The aim of this project is to provide an integrated strategy to mitigate the risk posed to workers dealing with nanoparticles. Discussions held over the course of the two day meeting therefore focused on the tasks organised to create this strategy, namely which engineered nanoparticles to characterise, how best to carry out hazard and exposure assessments, and ways in which risks will be assessed and managed. Industrial case studies and training procedures were also looked at.

Having held long discussions over the course of the workshop, participants returned home with a clearer understanding of how they will play their role in providing a safer working environment for workers handling nanomaterials in the paints and inks industry.

Humboldt University replaces Aveiro in Project

Humboldt University of Berlin has officially replaced Aveiro University in the nanoMICEX project. This change comes after the transfer of personnel involved in this project from the one university to the other.

The removal of Aveiro and the subsequent addition of Humboldt was approved by all partners involved in the nanoMICEX project.

In recognition of these necessary changes in staffing, the deadlines for a couple of the deliverables in Work Package one were pushed back by a few months.

Change in Personnel

Martie van Tongeren from the Institute of Occupational Medicine (IOM) has joined the personnel working on the project.

He replaces Steve Hankin as the organisation's lead contact for the nanoMICEX project.

Figure 18. Fragment of the project newsletter

4. References

LIST OF FIGURES

LIST OF TABLES

NANOMICEX is a collaborative project funded by the European Community´s Seventh Framework Programme (FP7/2007 – 2013) under Grant Agreement n. NMP4-SL-2012-280713