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Name, title and organization of partner: **Dr. Srinivasan Anand, KTH; Dr. Elen Garcia, ICFO**

E-mail: anand@kth.se, projectmanager@icfo.es

Project website address: www.nanophotonics4energy.eu

Reporter and scientific representative of the coordinator:	
Dr. Srinivasan Anand KTH	Dr. Gonçal Badenes ICFO

Update on the database of resources and progress towards a virtual network

This report refers to the update of the Network of Excellence Database and progress towards a virtual network included in WP1 “Creating a Nanophotonics for Energy Efficiency Forum”, reported now on deliverable D 1.7.

Lead summary:

In the **first phase**, network resources – expertise, skills, facilities and equipment- available at the partners were collected and available for internal use. The intension was to have a living document, for possible updates/refinements.

In the **second phase**, the database was made public with open access from the network’s website. Other specific implementations included a single contact point for the whole network to manage requests for information or projects from outside the network.

In the **third phase**, a N4E resource pack document was generated which focuses on facilities, equipment, characterization, software and computing infrastructure, under specific and easily identifiable headings, e.g. large scale facilities, micro and nano fabrication and manufacturing, epitaxial technologies, etc. In addition, brief explanations – purpose, specs, process conditions - for a large number of equipment were added. The N4E resource pack is now openly accessible.

In the **fourth phase** (present report) the N4E resource pack was retained and there were no major changes in partner facilities. The use of the N4E resource pack by network partners and by associate members, engaged in the PV and lighting sectors, triggered by the network activities is a positive development. The network has been successful in attracting associate members, which has now grown by 10-fold from initial 4 (year 2) to 41. The participation of the associate members in the network activities is very high – to-date more than 80% of the associate members are actively involved in the network. The young researcher exchange program was continued. Exchanges with associate members were also encouraged. During year 4, the concept of a virtual Lab was discussed and a remote eLab infrastructure was identified as a potential mechanism for integration and access to facilities and expertise. A pilot eLab activity is foreseen for the project extension into year 5.

Regarding **the virtual network**, the previously implemented mechanisms are retained, and the results have been rather positive. Existing tools –project website, LinkedIn, twitter and Facebook are used to disseminate events, information on the Seed Projects Calls, associate membership, relevant information for nanophotonics for energy efficiency.

Plans and actions for the next phase: The network plans to continue with the implemented tasks/mechanisms owing to the clear positive indicators. Specifically, efforts on updating the database of resources including the N4E resource pack, integrating new associate members, organizing network meetings/workshops, young research exchanges, and virtual networking via social networks will be continued. A new effort will be on the development of a prototype of an initial-phase remote eLab infrastructure, which will allow to carry out measurements on an experimental set up located at the University of Southampton by researchers located at remote locations through their computer. The plan is to further expand the capabilities and the number of experimental setups in efforts to be carried out after the end of the project.

Development

Tasks implemented and details:

1. Database of resources

The major effort in year 3 was in generating a N4E RESOURCEPACK [D1.5_annex1_resourcepack] by collecting information on facilities, process equipment etc available at partner sites. The central idea with this initiative was to provide technical information on facilities and equipment – technical description, purpose, available processes and specs.

During year 4, there were no major changes in partner facilities that would affect the information in the N4E resource pack. However, in the next phase a final update of the resource pack will be made together with inclusion of the specific tools developed/adapted for the remote e-lab infrastructure.

Concerning use of facilities, several partners already use complementary facilities triggered by research exchanges and common projects. For example, UPC and CSIC_madrid; UPC and ICFO; BILKENT and TUD; UPC and KTH. Outside the network partners, also such usage of facilities exist with institutions/industries involved in the PV/LED sectors or related. Examples, include Associate Members URJC and IMDEA using facilities at CSIC-Madrid. Solvoltaics AB, Midsummer AB, Obducat Technologies AB, and Acreo Swedish ICT, Kista, Sweden use the fabrication/measurement labs at KTH; Aledia and CEA-LETI are closely connected. It is anticipated that many of the cooperations existing (and new ones) with network partners and associate members will result in the use of the N4E resource pack.

2. Associate members and their participation in N4E activities

Since the establishment of an Associate Membership status, the network has made significant efforts to attract relevant players, both in academia and industry, to join the network as associate members. The network had organically grown by actively including 41 new associate members to the 9 N4E project partners. This successful growth was enabled by partner driven initiatives, the visibility of the network and opportunity for targeted participation via seed project scheme, and recommendations/contacts from the industrial board.

A significant number of them – **80%** - are actively involved in the network - participating in seed project applications or project applications outside the network (EU, national etc), N4E organized/hosted workshops and related events, and some have ties with one or more network partners.

Table D1.7.1 gives detailed information mapping the associate members and their engagement with N4E. THIS TABLE IS A LIVING DOCUMENT OF ASSOCIATE MEMBER ACTIVITY IN THE N4E NETWORK. UPDATED INFORMATION FOR YEAR 4 ARE HIGHLIGHTED IN GREEN.

% of associate members involved N4E related activities:

END OF YEAR 4: *Participation in N4E activities has remained very high. 80% are involved in N4E activities (seed projects, events, cooperation with N4E partner or partners). Several associate members are new to the network and more participation is anticipated in future.*

73% in N4E seed project scheme and other joint projects with partners; 46% involved in N4E events (workshops etc).

Table D 1.7.1: Engagement of Associate members (@end 2013) with N4E:Activity and Event map

	Associate member	Engagements in Research collaboration with N4E Seed project (SP): Short name; Call # (1-6); N4E partners. OR Cooperation with N4E partner	Engagements in Workshops and related events organized by N4E N4E Event; [Role]
1	Aalto University	Aalto Univ and KTH are partners in Nordic Innovation Center's project "Nanordsun" Oct 2010-Oct 2013, on nanowire solar cells SP: SORINS; 6 th call; KTH	Erice school nanophotonics for energy, 8-13 Nov 2011; [participant] Joint meeting with Nordic consortium Nanordsun, 23-24 April, 2012, Stockholm

			[Nordic partner]
2	Abengoa Research		Hybrid Nanophotonic workshop, 25-27 March 2013, Southampton, [participant]
3	Acreo AB	SP: BE-LED, 5th call; ICMM-CSIC Cooperates closely with KTH	N4E Industry-Academia workshop, 7-8 Nov, Grenoble, 2012 [Discussion Panel] 2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker]
4	AMO GmbH	SP: DIS-PHO-CELL; 5 th Call; LENS	N4E Industry-Academia workshop, 7-8 Nov, Grenoble, 2012 [Discussion Panel]
5	Arçelik	SP: X-MAX, 6th call, BILKENT	
6	CEA-LITEN	CEA and UPC are partners in project "ENTHIPV/ Encapsulation thin photovoltaics", KIC INNOENERGY	N4E Industry-Academia workshop, 7-8 Nov, Grenoble, 2012 [Participant]
7	Chalmers University of Technology (CTH)		2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker]
8	CNR, Institute for Photonics and Nanotechnologies		
9	CORNING /Corning European Technology Center (CETC)	SP: FLEXINANO, 6th call, ICFO	
10	CSIC, Instituto de Microelectrónica de Madrid- Nanophotonic Devices Group	SP: BE-LED, 5th call; ICMM-CSIC	
11	Humboldt Universität Berlin	SP: OLEIT; 4th call; LENS	Hybrid Nanophotonic workshop, 25-27 March 2013, Southampton, [speaker]
12	IBM Research GmbH	SP:ASOL-QDLASER; 6th call; BILKENT & CSIC	Hybrid Nanophotonic workshop, 25-27 March 2013, Southampton, [speaker]
13	IMEC	SP: NANOIII-V/Si PV; 5th Call; KTH	N4E Industry-Academia workshop, 7-8 Nov, Grenoble, 2012 [Participant]

			2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker]
14	INESC-University of Porto		
15	INL, Institut des Nanotechnologies de Lyon		
16	IESL -FORTH	IESL-FORTH and US are partners in EU FP7 project ITN-Icarus: "Hybrid organic-inorganic nanostructures for photonics and optoelectronics " 2010-2013	Hybrid Nanophotonic workshop, 25-27 March 2013, Southampton, [speaker]
17	Institute of Materials Science of Seville, Multifunctional Optical Materials Group		2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker] n4e 1st Users Meeting Madrid 19-20 June 2013 [speaker]
18	Institute of Solid State Physics, University of Bremen	SP:BLACK SI SOL; 6 th call; KTH	
19	IREC Catalonian Institute for Energy Research	Cooperates with TUD and intends for a seed project appln.	
20	King's College London	SP: ILLUME; 4 th Call; ICFO	Complex Nanophotonics summer camp Aug 2013 [organiser]
21	LEITAT Technological Center	SP:FASPV; 6 th call; UPC	n4e 1st Users Meeting Madrid 19-20 June 2013 [speaker]
22	LightLab AB	SP, FEELgiantQDs; 4th Call; KTH and BILKENT	
23	Moscow Institute of Physics and Technology (State University), Laboratory of Nanooptics and Plasmonics	With LENS - Marie Curie or other similar instruments are being discussed	
24	Norwegian University of Science and Technology (NTNU)	NTNU and KTH are partners in Nordic Innovation Center's project "Nanordsun" Oct 2010-Oct 2013, on nanowire solar cells	Joint meeting with Nordic consortium Nanordsun, 23-24 April, 2012, Stockholm [Nordic partner]
25	Obducat Technologies AB	SP: RANDWHILED; 2 nd call; LENS and US SP: HyperLED; 3 rd Call; LENS and US	Joint meeting with Nordic consortium Nanordsun, 23-

		SP: RANPV; 3 rd Call; US and LENS SP: NANOSOL; 4 th Call; KTH SP: NANOIII-V/Si PV; 5th Call; KTH SP: FUNCAPSOLAR; 5th Call; KTH and UPC	24 April, 2012, Stockholm [Nordic partner] 2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker]
26	Oxford Photovoltaics Ltd.	SP: PLPV; 4 th Call; US	
27	SECOL	SP; Macrocryst-QD; 4th call; BILKENT and TUD SP: CRYST-QD; 5 th Call; TUD and BILKENT SP: MULTICOL-LASE; 5th call; BILKENT and ICMM-CSIC	
28	SGENIA		
29	SAMEER, Society for Applied Microwave Electronics Engineering and Research		
30	Solibro Research AB		2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm [speaker]
31	Technological Educational Institute of Crete	SP: PLPV; 4 th Call; US	
32	Universidad Autónoma de Madrid IMDEA Nanosciences	SP: BE-LED, 5th call; ICMM-CSIC proposal to Research Program within Madrid Region Together with CSC (partner) and URJC (associate member)	N4E Industry-Academia workshop, 7-8 Nov, Grenoble, 2012 [Participant] n4e 1st Users Meeting Madrid 19-20 June 2013 [speaker]
33	Universidad Rey Juan Carlos -Organic Optoelectronics Group	Cooperates with ICMM-CSIC and interested in seed project application proposal to Research Program within Madrid Region Together with CSC (partner) and IMDEA (associate member)	
34	Universidad Rey Juan Carlos, Electronic and Photonic Organic Devices Group		n4e 1st Users Meeting Madrid 19-20 June 2013 [speaker]
35	Universitat Rovira i Virgili	SP:TUBAPHO; 6th call, ICFO	n4e 1st Users Meeting Madrid 19-20 June 2013

			[speaker]
36	Université Libre de Bruxelles, Theoretical Nonlinear Optics Group	SP: WHISFI; 6th call; ICFO	
37	University of Cambridge, Chemistry Department		
38	University of Mons	Cooperates with KTH on nanoscale analysis of organic PV Marie-Curie or similar instrument with KTH planned	
39	University of Oxford	SP: ADOCOQUADOP; 5 th Call; ICFO	
40	University of the Basque Country, NanoPhysics Lab		
41	Zumtobel Group		

3. N4E network website:

Since the start the network's website <http://www.n4e.eu> has continually evolved, via feedback of network partners, reviewers, and others accessing the network website, to effectively reflect the various network tasks and integration mechanisms. The website is continuously updated to provide all relevant information up-to-date. No specific need was seen to change the information format of the website.

4. Research Exchange:

The objective to promote integration via exchange of young researchers between network partners, and between associate members and network partners. During year 4, 9 research exchanges were performed and summary is given in the table below.

YOUNG RESEARCHER EXCHANGES: N4E // year 4 // A SUMMARY

Name of young researcher	Sending Partner	Receiving site P: partner; AM: associate member	Period 2013 (duration: # days)	Brief statement of purpose Outcomes, if any (e.g publication, seed project etc)
Christin Rengers PhD student	TUD	BILKENT	October; THREE WEEKS	During the research trip, two topic fields were handled. New characterization methods and application fields for highly emitting In(Zn)P/GaP/ZnS QD, recently established at TUD, were investigated. The second topic investigated was the use of silica encapsulated QDs in distributed

				Bragg reflectors (DBR).
André Wolf PhD Student	TUD	KTH	November; ONE WEEK	Participated in the N4E industry-academia Workshop. Visited the clean room and other labs at KTH; and had detailed discussions with different research groups at KTH and ACREO. Some topics, for example spray coating and QD-gels, for collaborations were identified.
Dr. Vladimir An From Tomsk Polytechnical University, Russia		TUD	November, TWO WEEKS	Dr. An is Associate Professor at the Department of Nanomaterials and Nanotechnologies and is an expert in self-propagating high temperature synthesis of metal and semiconductor nanomaterials. Dr. Vladimir gave a tutorial (including presentation and practical teaching), helped in the design of the synthesis setup. Associate membership.
Dr. Sergei Voitekhovich From Belarussian State University		TUD	November, ONE WEEK	Dr. Voitekhovich is a senior scientist and a world recognized expert in the field of synthesis of very powerful stabilizer for colloidal nanocrystals: molecules of tetrazoles. The visit was devoted to training of students on synthesis and handling of tetrazoles, as well as to planning of a joint research project. A specially designed tetrazole molecule was synthesized during the visit and was recently utilized in TUD group to fabricate novel light-emitting aerogel potentially suitable for solid state lighting applications. The manuscript "3D Assembly of Silica encapsulated Semiconductor Nanocrystals", by Christin Rengers, Sergei V. Voitekhovich, Zoran Popović, Nikolai Gaponik and Alexander Eychmüller is presently in preparation for submission to Chemistry of Materials.
Yusuf Kelestemur	BILKENT	TUD	June, ONE	Worked on on-going joint projects

PhD student			WEEK	between BILKENT and TUD on Q-dots
Dr. Apurba Dev	KTH	Institute of solid state physics, University of Bremen	April, 4 days	Semiconductor optics group at the University of Bremen has long experience in laser processing of semiconductors, -including doping. This visit was used to discuss the potential of the scanning probe techniques to investigate on the microscopic electrical properties of the laser processed Si and ZnO; and to also used to draft a work plan /proposal for a seed prepare the seed project proposal BLACK SI SOL; 6th call.
Dr. Dmitry Yu. Fedyanin	Moscow Institute of Physics and Technology (associate member)	LENS	Two exchanges were made	Discussions on Nanophotonics and plasmonics and joint projects.
Arnau Coll	UPC	KTH	November, ONE WEEK	Visits to clean room and labs at KTH-Kista. Nanofabrication of Si and related technologies were investigated together with a PhD student at KTH. Samples prepared were optically characterized. Introduction to SCM and SSRM measurements and discussions of previously obtained results on laser-doping of Si made at UPC. Visit also included exchange of samples for continuation of measurements.
Ana Belen Morales Vilches	UPC	KTH	November, ONE WEEK	Visits to clean room and labs at KTH-Kista. Nanofabrication of Si and related technologies were investigated together with a PhD student at KTH. Samples prepared were optically characterized. Introduction to SCM and SSRM measurements and discussions of previously obtained results on laser-doping of Si made at UPC. Visit also included exchange of samples for continuation of measurements.

5. Towards a virtual network:

Following the feedback received, the initiative to connect with the community via professional and social networks was continued. “Nanophotonics for Energy Efficiency” group in LinkedIn

(<http://www.linkedin.com/groups?mostPopular=&qid=3705807>) is a socio-professional network and continues to be the preferred choice in comparison to Facebook and Twitter. The activity in these links is also directly tagged/visible on the network website.

6. Integration via Network meetings and conferences:

During year 4, the network organized the following workshops/meetings with an aim for wider participation of associate members and others: (1) Hybrid Nanophotonic workshop, 25-27 March 2013, Southampton; (2) n4e 1st Users Meeting Madrid 19-20 June 2013; and (3) 2nd Industry-Academia Workshop, 11-12 Nov 2013, Stockholm. All these events had appreciable number of participants and several associate members were involved either as speakers or participants [detailed in section 2, table 1.7.1]. Besides these, the network partners have been actively involved in conference organization (topics in full or part related to N4E) increasing the visibility of the network. Examples of such conferences include: (i) CEA-LETI assisted at ForumLED 2013; (ii) KTH was involved in the organization of PIERS 2013 conference in Stockholm; (iii) KTH organized the Advanced optics and photonics – ADOPT center winter school Nano- and Biophotonics; (iv) LENS was involved in organization of NCAMA-2013 conference, Tiruchirapalli, India; (v) UPC was involved in EU PVSEC (Paris) 2013 assisting the N4E workshop within the conference and in the MNE2013 (Micro and Nano Engineering) conference (London).

Several new cooperations with associate members have emerged by participation in these events, and are indicated on table 1.7.1. In some cases, new partnership has also developed – for example, cooperation of TUD, CEA-LETI, and Bilkent with Aledia (Grenoble) resulted from N4E Industry-Academia Workshop in Stockholm; KTH with Solvoltaics.