

UKIERI PROJECT CLOSURE REPORT

Project Details

Project Title	Multifunctional hybrid nanocomposites for the separation of toxic and microbial contaminants from water
Project Reference number	IND/Cont (E) 14-15/055
UK Project Leader	Dr. Tapas Sen
India Project Leader	Prof. Asim Bhaumik
UK Institutions	University of Central Lancashire
Indian Institutions	Indian Association for the Cultivation of Science
Project Start Date	4 th July 2014
Project Completion Date	31 st December 2016
Project Closure Report Submission Date	8 th January 2017

Project Closure Report

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Project Closure Report

1 PROJECT PERFORMANCE

1a. Provide very brief information on the objectives of the project with focus on key five highlights.

The specific objective of the project was to develop multifunctional hybrid nanocomposites for the removal of toxic metal ions (i.e. arsenic, cadmium, lead) and to tackle the bacterial contaminants such as Legionella, E-Coli (E-Coli O157 and O104), Shigella and Salmonella from water.

5 key highlights

- **Research and development**
 - Development of multifunctional inorganic-organic hybrid nanocomposites
 - Important properties such as ion-exchange, superparamagnetic, antimicrobial, surface functionalised with specific primers of water-borne microorganisms such as E-Coli and Salmonella
 - Removal of both As⁵⁺ and As³⁺ from contaminated water using model water system with efficiency in the order of less than 10 ppb
 - Exceptional antimicrobial efficiency of water contaminated with two specific microorganisms such as E-coli and Legionella
- **Proto-type development**
 - Development of a proto-type (demo-kit: A cartridge) for the simultaneous removal of arsenic ions (As³⁺ and As⁵⁺) using a modified form of a cheap commercial resin
- **Dissemination activity**
 - Several high impact journal publications
 - Keynote presentations at several National and International conferences
 - An International workshop organised by UK Lead partner (20th August 2015) (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>)
 - An International conference organised by UK Lead Partner (29th to 31st March 2016) (<https://nanosymposiumatuclan.net/>)
 - A special focus issue in high impact journal “Nanomedicine” (Vol.11, No.21, Nov’16) (<http://www.futuremedicine.com/toc/nm/11/21>)
 - A special issue in Materials Today: Proceedings, Elsevier due to be published in Jan-Feb’17 issue
- **Outreach activity**
 - Secondary school students in Lancashire (<https://nanowateratuclan.org/outreach-activities/>)
 - General public and business leaders at several TechConnect and business meetings both in Europe and America
- **Sustainability**

Close collaboration among the existing consortium members (both academic and Industrial partners) from UK and India via new application under Newton-Bhabha Fund and GCRF-RCUK collective funding on “Water, Sanitation and Hygiene (WASH) analysis using Nano / Biotechnological Materials and Tools”

1b. Provide specific details of deliverables and outcomes in the table below.

Deliverables included in the Work Plan	Outputs	Milestone and Achievements
D1. At least 10g of multifunctional nanocomposites developed under task 1 and 2 – M9	Both D1 and MS-1 have been met on time. Direct: 2 journal articles Indirect: 3 journal articles on Nanomedicine with a special issue	MS-1: An optimised protocol for the fabrication of high surface area novel superparamagnetic inorganic-organic hybrid nanocomposites with antimicrobial property Has been successfully achieved and published in peer-review journals
D2. Provision of at least 5g (tested and optimized in a model assay system) hybrid nanocomposites surface patterned with capture single stranded DNA primer (i.e. E.coli and Legionella) for the use in separation of microorganisms and tested in real samples through colony forming unit (CFU) counts – M18	Both D2 and MS-2 have been met on time. 1 journal article is in press	MS-2: An optimised protocol for the grafting of primers by chemical conjugation and their efficiency in capturing complementary sequence Has been successfully achieved and applied in demo-kit preparation as a part of pro-type development
D3. A 'demo kits' in the form of a cartridge using multifunctional hybrid nanocomposites for simultaneous separation of Arsenic (toxic) and Ecoli / Legionella / Salmonella / Shigella / Vibrio (microbial) from water collected from the region of West Bengal – M22	Both D3 and MS-3 have been met on time. 2 journal articles published and 1 journal article has been submitted.	MS-3: An optimised protocol the separation of Arsenic from ground water using multifunctional nanoparticles under magnetic field Has been successfully achieved and applied in demo-kit preparation as a part of pro-type development along with the publication in 2 peer-review journals
		MS-4: An optimised protocol the separation of Legionella / E-coli / Salmonella / Vibrio / Shigella from ground water using multifunctional nanoparticles under magnetic field MS-4 has been partially met using Legionella / E-coli / Salmonella but haven't tested for Vibrio / Shigella.

1c. Provide project statistics in the table below.

Project Statistics	
Total number of faculty directly benefitted through the project and related activities since its inception	4
Total number of faculty benefitted indirectly through the project and related activities since its inception	2
Total number of students benefitted directly through the project and its related activities since its inception (Masters/PhD and Post-Doctoral students)	4 PhD and 1 MPhil students + 3 Post-doctoral fellow
Total number of students benefitted indirectly through the project and its related activities since its inception (Masters/PhD and Post-Doctoral students)	2 PhD, 5 MScs and 2 MChem students
Number of any other external individuals/institutes (outside of Partner Institutions) involved in & benefiting from the project or related activities. Please include details of the individuals/institutes.	1 Prof Nikhil Kumar Singha at IIT Kharagpur, India

Details of staff and student exchanges from the UK to India and India to the UK since inception of the project	<p>UK to India visits</p> <p>Dr Tapas Sen, UK Project Lead: August 2014 Dr Tapas Sen, UK Project Lead, April 2015 Mr Gary Hogben, UK Industrial partner, April 2015 Mr Qurban Ali, UK Student, could not visit due to visa issue Dr Yogita Patil-Sen, UK PDF, September- October 2015 Ms Amritvir Kaur, UK Student, December- January 2016 Dr Tapas Sen, October-November 2016</p> <p>India to UK visits</p> <p>Prof Asim Bhaumik, India Project Lead, October 2014 Ms Piyali Bhanja, Indian student, January - February 2015 Prof Asim Bhaumik, India Project Lead, August 2015 Prof Asim Bhaumik, Indian Project Lead, March 2016 Ms Piyali Bhanja, Indian student, March 2016 Dr Debabrata Rautaray, Indian Industrial Partner, Mar' 2016 Mr Subhajit Bhunia, Indian student, May 2016</p>
Any joint agreements/MoUs	An NDA agreement has been signed by all consortium members in August 2013
Number of PhD Thesis submitted	1 MPhil thesis submitted and examined from the University of Central Lancashire (UCLan, UK), 1 PhD thesis submitted from IACS, Kolkata, India, 2 PhD thesis under submission from UCLan, UK and 2 PhD thesis under submission from IACS, Kolkata, India
Details of Curriculum development / Course development	Partial contribution in delivering FZ4609 module at level 7 of MChem, 4 th Year at the University of Central Lancashire, UK Developed a document under out-reach activity for secondary school students at Lancashire, UK (see the link: https://nanowateratucan.org/outreach-activities/)
Details of Train the Trainer modules, resources and actual training beneficiaries	<p>FZ4609 involved development of hybrid nanocomposites as a part of laboratory practical of 4th year MChem students who have been benefitted.</p> <p>In addition to the above, 1 MPhil student and 6 PhD students and 3 post-doctoral fellows were fully trained and benefitted from the project.</p>

1d. Provide details of project outreach activities.

Project Outreach	
Details of Media Coverage (newspaper, magazine articles, newsletters etc.) with online links or as attachments	<p>Project dissemination activity "1st International Symposium on Functional Nanomaterials in Industrial Applications: Academic – Industry Meet" 29th to 31st March 2016, UCLan, Preston, UK in the following Newsletters</p> <p>UCLan, UK: http://www.uclan.ac.uk/news/world-science-event.php Azo Nano, USA: http://www.azonano.com/news.aspx?newsID=34593 Video: https://www.youtube.com/watch?v=imWlWG0eeSA&feature=youtu.be Halton Chamber of Commerce and Enterprise: http://www.haltonchamber.co.uk/news/nano-symposium.html</p>
Details of additional support from both the institutions in cash and in-kind (Do not mention the in kind support already	Additional contribution for Project dissemination activity "1 st International Symposium on Functional Nanomaterials in Industrial Applications: Academic – Industry Meet" 29 th to 31 st March 2016, UCLan, Preston, UK

mentioned in budget proposal)	(https://nanosymposiumatuclan.net/) by the followings: Industrial sponsorship, institutional contribution and partial delegate fees: £15970
Details of leveraged funding received during the course of the project	No
Joint Research papers published in journals (mention title of paper and name of the Journal and no. of citations)	<p>Mesoporous BaTiO₃@SBA-15 derived via solid state reaction and its excellent adsorption efficiency for the removal of hexavalent chromium from water. V. Kumari, M. Sasidharan and A. Bhaumik, <i>Dalton Transactions</i> 2015, <i>44</i>, 1924-1932. Citations = 11</p> <p>A magnetically recoverable nanocatalyst based on functionalized mesoporous silica. P. Bhanja, T. Sen and A. Bhaumik, <i>Journal of Molecular Catalysis A: Chemical</i> 2016, <i>415</i>, 17-26. Citation = 1</p> <p>Triazine containing N-rich microporous organic polymers for CO₂ capture and unprecedented CO₂/N₂ selectivity. S. Bhunia, P. Bhanja, S. K. Das, T. Sen and A. Bhaumik, <i>Journal of Solid State Chemistry</i> (Accepted, 2017).</p> <p>Mesoporous ZnAl₂O₄: an efficient adsorbent for the removal of arsenic from contaminated water. V. Kumari and A. Bhaumik, <i>Dalton Transactions</i> 2015, <i>44</i>, 11843-11851. Citations = 12</p> <p>Q, Ali, W. Ahmed, S. Lal and T. Sen "Novel Multifunctional Carbon Nanotube Containing Silver and Iron Oxide Nanoparticles for Antimicrobial Applications in Water Treatment" <i>Materials Today: Proceedings</i>, by Elsevier (in press)</p> <p>A. Kaur, T. Mercer, A. Bhaumik and T. Sen "Multifunctional hybrid inorganic-organic nanocomposites for the removal of toxic pollutants from water" <i>Water Research</i>, by Elsevier (Submitted)</p>
Joint Research papers presented at international conference/seminars	<p>"Nano-composites Applied in Sewage Water and Bio-separation" by Tapas Sen UCLan China-UK Science and Innovation Exhibition and Symposium, Shenzhen, China, December 1-2, 2014 (http://www.britchamgd.com/ArticleShow.aspx?AClassID=40&ArticleID=1175&LanguageID=1)</p> <p>"Synthesizing multifunctional nanocomposites for the removal of valuable and toxic metal ions from along with water-borne microbes from contaminated water" by Amritvir Kaur and Tapas Sen 4th International symposium: Nanotek & Expo, December 01-03, 2014 San Francisco, USA, (http://nanotechnology2014.conferenceseries.net/poster-presentation.php)</p> <p>"Recent Development of Multifunctional Nanocomposites in Water Technology" by Qurban Ali, Amritvir Kaur, Eric Jones, Lingzhi Wang, Gary Hogben, Asim Bhaumik, Nawal Kishor</p>

Mal and Tapas Sen
TechConnect World Innovation, Conference & Expo, June 14-17, 2015, Washington DC , USA
(<http://www.techconnectworld.com/Nanotech2015/bio.html?id=116>)

“Magnetic Nanoparticles Research at IACS, Kolkata, India” by Asim Bhaumik
International workshop on Magnetic Nanoparticles, 20th August 2015, Preston, UK (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>)

“Magnetic Nanoparticles Research at UCLan”, Preston by Tapas Sen
International workshop on Magnetic Nanoparticles, 20th August 2015, Preston, UK (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>)

“Water Research at Feedwater Ltd., UK” by Gary Hogben
International workshop on Magnetic Nanoparticles, 20th August 2015, Preston, UK (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>)

“Nano Research at Tata Chemicals Ltd., India” by Debabrata Rautaray
International workshop on Magnetic Nanoparticles, 20th August 2015, Preston, UK (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>)

“Nano Applications & its Industrialization: Nano Product Development & Research Overview of Tata Chemicals Innovation Center, Pune, India” by Debabrata Rautaray
An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (<https://nanosymposiumatuclan.net/>).

“Microbial challenges in water supply - maintaining sage water in buildings” by Gary Hogben
An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (<https://nanosymposiumatuclan.net/>).

“CO₂ Capture and Fixation over Organic and Organic-Inorganic Hybrid Porous Nanomaterials” by Asim Bhaumik
An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (<https://nanosymposiumatuclan.net/>).

“An overview of nano and nano-biotechnology research at UCLan, Preston” by Tapas Sen
An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (<https://nanosymposiumatuclan.net/>).

“Removal of As (III) and As (V) Ions from Water by single step magnetic separation using Magnetized Resin” by A

	<p>Kaur, A. Bhaumik and T. Sen An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (https://nanosymposiumatuclan.net/).</p> <p>“Development Of Prototype Carbon Based Magnetic Nanocomposites For Removal Of Organic Pollutants Present In Water” by E. Jones, N. Costa and T. Sen An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (https://nanosymposiumatuclan.net/).</p> <p>“Development of novel multifunctional carbon nanotube nanocomposites containing silver and iron oxide nanoparticles for antimicrobial efficiency in water treatment” by Q. Ali, W. Ahmed, S. Lal, T. Sen An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (https://nanosymposiumatuclan.net/).</p> <p>“Superparamagnetic Fe₃O₄-grafted functionalized mesoporous silica for the synthesis of biodiesels” by P. Bhanja, T. Sen and A. Bhaumik An international symposium “Functional Nanomaterials in Industrial Applications: Academic – Industry Meet” 29th-31st March 2016, UCLan, Preston, UK (https://nanosymposiumatuclan.net/).</p> <p>“Sustainable Nanotechnology in Cleanwater” by Tapas Sen TechConnect Live, Dublin, 31st May 2016 (http://techconnect-live.com/speaker/tapas-sen/)</p> <p>“Sustainable Nanotechnology in Cleanwater” by Tapas Sen 2nd Surface Science & Engineering conference, 30th June 2016, Cranfield University, UK</p>
Project workshops	<p>Title of the workshop: International workshop on Magnetic Nanoparticles (https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/) Date /Place: 20th August 2015, University of Central Lancashire, Preston, UK No. of participants: 80 Relevance of workshop to the project/how did workshop proceeding contribute to project: The workshop theme was directly relevant to one of the important topics “Superparamagnetism” and how that can influence on “Multifunctionality” of inorganic-organic hybrid nanocomposites for magnetic separation following water purification.</p>
Any Corporate support to the project in-cash or in -Kind	Facilities, staff times, students’ bench fees and technical staff times from academic and industrial partners of the consortium
Has project work contributed to work of any Corporate/SME	The industrial partners FeedWater Ltd., UK and Tata Chemical Ltd., Pune, India were involved in the project hence some work have been tested over the industrial environment and contributed towards their understanding.

Has project work led to formation of any SME or creation of jobs? If yes please provide the details	No
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1e. UKIERI Objectives

Include an evaluation of the project's deliverables against the following criteria to ensure the investment made has been justified

Dissemination and Impact	<p>Dissemination has been carried out <i>via</i> the following pathways:</p> <ul style="list-style-type: none"> • Relevant training and education to students for PhDs, MPhil, MSc and MChem degrees • Training to secondary school students <i>via</i> outreach activity (https://nanowateratuclan.org/outreach-activities/) • Presenting project work <i>via</i> poster, oral, keynote and plenary talks in several National and International conferences, TechConnect and business events • Publication in peer-review journals (see section 1d) • Publication in Newsletters (see section 1d) • Publication of leaflets and handouts (https://nanowateratuclan.files.wordpress.com/2016/02/tri-fold-brochure_nanowateratuclan.pdf) • Publication of pull-out banner (https://nanowateratuclan.files.wordpress.com/2016/02/pull-up-banner-2_2nd-version.pdf) • Publication <i>via</i> a dedicated project website (https://nanowateratuclan.org/) • Special group of researchers <i>via</i> an International workshop (https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/) • International scientific community from academic, Industry, publishers, Government agencies and General public etc. <i>via</i> an International symposium (https://nanosymposiumatuclan.net/) <p>Impact</p> <ul style="list-style-type: none"> • A special focus issue in one of the top journals "Nanomedicine" covering the best research articles presented in the International conference (https://nanosymposiumatuclan.net/) <i>via</i> a stringent peer-review process (http://www.futuremedicine.com/toc/nnm/11/21) • A special issue in Materials Today: Proceedings, Elsevier covering the Nanocomposites in nano-water research and nano-energy due to be published in Jan-Feb'17 issue • Created an extensive network of scientific community both from academic and Industrial organisations outside India and UK. Consequently, two new grants submission has been possible in order to create a long-term sustainability • Created public health awareness on Arsenic pollution in water worldwide, specifically in the Eastern part of India <i>via</i> the dissemination activity under the project. • Created public health awareness on microbial pollution
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	in water due to poor hygiene and sanitation in India <i>via</i> the dissemination activity under the project.
Mutuality and Complementarity	The project consortium formed by two academic and two industrial partners with relevant experience on different aspects of the project objectives. Indian project lead dealt with Organic and UK project lead dealt with Inorganic part for the development of hybrid inorganic-organic nanocomposites. Both groups are well established in the area of Nanocomposites research and their application in Water technology. The research outcomes in two academic labs were underpinned by two industrial partners for the development of a proto-type demo-kit. FeedWater Ltd. UK is specialised on microbial esp. Legionella control and Tata Chemicals Ltd., India is specialised in Nanocomposites for the removal of toxic metal ions.
Contribution to Step Change	Competitive and portable demo-kit for simultaneous removal of both As ⁵⁺ and As ³⁺ in the limit of less than 10 ppb (parts per billion) level from arsenic contaminated water. It would be an ideal system for arsenic decontamination.
Sustainability	A new project proposal has been submitted under GCRF-RCUK funding scheme for further development and commercialisation of the research outcomes with the existing consortium partners both from UK and India. The consortium is actively seeking for further development.
Achievement of Outcomes	Crated an international network involving several top academic and Industrial organisations who are keen to work together in the area of Nano-water technology due to our excellent project dissemination activity. Hence a clear outline of further development of the project objectives for long term sustainability is now in place involving both academic and industrial organisations.

1f. PROJECT OUTCOMES

- **Provide details of benefits to UK and Indian Institutions accrued through the project**
 - A life time opportunity to work together in the area of Nano-water research in collaboration with two industrial organisations one from UK and one from India.
 - Life time experience of faculty members, students, post-doctoral fellows from academic organisations working in two different countries and the corresponding laboratories
 - Life time experience of faculty members, students, post-doctoral fellows from academic organisations working in industrial environment at Tata Chemicals Ltd., India and FeedWater Ltd., UK
 - New skills such as health & safety measure, ethics, languages, team-working etc. due to the exchange visits
 - Created an international reputation in the area of nano-water research and extended to Nano-medicine *via* the following important outcomes:
 - High impact journal publications which will be a direct measure of REF2020 (Research Framework Excellence), an assessment criteria for UK funding council
 - A special focus issue in a high impact journal "Nanomedicine" (Vol.11, No.21, Nov'16) both as an online version (<http://www.futuremedicine.com/toc/nnm/11/21>) and printed copy in libraries worldwide
 - A special issue in Materials Today: Proceedings, Elsevier due to be published in Jan-Feb'17 issue

- Completion of PhDs and MPhil degrees which will be a direct measure of REF2020 (Research Framework Excellence), an assessment criteria for UK funding council
 - A substantial project funding from UKIERI and DST, India and without that, it wouldn't have been possible
- **Provide details of impact that the output/activity has created or is expected to create**
 - Novel Materials, Methods and know-how for potential commercialisation products and improvement of quality of water in both developing and developed world
 - Revenue generation in the future *via* the commercialisation process with the help of two industrial organisations
 - Already created a worldwide network involving academic and Industrial organisations for future collaboration and grant capture due to the dissemination activity such as an International workshop (<https://nanowateratuclan.org/an-international-workshop-on-magnetic-nanoparticles/>) and an International symposium (<https://nanosymposiumatuclan.net/>)
 - A new research project submitted under GCRF-RCUK on Nano-water research for long term sustainability involving the same consortium members
 - A society of Functional Nanomaterials is on the process of creation at the University of Central Lancashire, UK involving local council, academic members, Industrial members and intellectuals for the promotion of Nano-research

2 STATEMENT OF EXPENDITURE

Provide signed-off Statements of Expenditure. These should be in same format as project proposal.

Please note that reports without signed statement of expenditure would be not be accepted.

(See attached as a separate file)

3. IMPORTANT LESSONS LEARNED

3a. Lessons learned for future reference

Provide information on any important lessons learned that would be useful for future reference for UKIERI. This could include information on the project approach, the resources, the technology, stakeholders, management organisation structure, management processes and benefits.

- Working in collaboration with academic and industrial organisations can dramatically increase the success of the research outcome
- A dedicated project website is extremely important for the dissemination and promotion of the project
- Meeting every objectives of the project within the set time-line and set funding can be challenging hence an extension of the project period was really helpful. In addition, an additional funding for an important dissemination activity (www.nanosymposiumatuclan.net) was very useful for the success of the event.
- Students' exchange visits mayn't always be an easy task due to the complexity of visa process for Pakistani citizen who was working in the project at UCLan, UK

- A project with 2 years duration is not sufficient for PhD thesis both in UK and India hence it is difficult to measure the number of successful completion.

3b. Comments on UKIERI

Please include any comments on the UKIERI management process.

- Extremely professional and responsible whilst day to day communication with the members of the UKIERI management team
- Deadlines and report templates were clearly presented well advance hence no confusion whilst running the project

4. WAY FORWARD

4a. Sustainability

- Provide details on how partnership is going to continue after UKIERI funding is over? Mention any additional funding already being secured, proposals in pipeline etc.)
- Provide details of any future work on this theme
- Include details of possible revenue generation mechanism, MOU's joint courses etc.
- Include details of future opportunities for institutions involved - Sectorial & nationally
- What has been the prosperity benefit through this collaboration to both countries

The existing consortium (UK Lead, Indian Lead, Indian Industry and UK SME) is actively seeking for small, medium and large grants *via* Newton-Bhabha Fund, Global Challenge Research Fund–Research Council UK, UKIERI funding, Innovate UK funding etc.

The consortium would like to continue the exploitation plan such as (i) scale-up production of hybrid inorganic-organic nanocomposites from lab-scale quantity and (ii) development of both static and portable water purification systems

The consortium is working and will continue to work on dissemination activity i.e. submission of joint journal articles from the current project, exchange visit through Royal Society scheme

The consortium has already signed a Non-Disclosure Agreement (NDA) and working together for the development of water filtration kits which may generate future revenues

A society for Functional Nanomaterials is due to be formed at the University of Central Lancashire where academic, Industrial organisations along with Government agencies will be involved both nationally and internationally.

Both countries (UK and India) have been benefitted from this project and prospered *via* the dissemination activity, especially through the International workshop and the International conference (<https://nanosymposiumatuclan.net/>). A funding mechanism between the two counties *via* UKIERI has been widely known by the International scientific community and consequently a similar scheme may develop with both countries in collaboration with other countries. In addition, several top academic and industrial organisations are considering working with UK and India in the near future.

5. Additional Information

Provide any additional information that you would like to furnish to support your report.

Additional documents included with this report as separate files

1. Signed statement of expenditure as a tabular presentation covering section 2 of the report
2. Dissemination folder containing high quality figures with description
3. Project banner and brochure as pdf copies
4. Special focus issues as pdf covering the dissemination