UCLAN-CHINA COLLABORATIVE PROJECT

Project title: Multifunctional Nanocomposites for the Separation of Pollutants from Industrial and Municipal Sewage Water

Project acronym: Nanocomposites
Project cost code UK part: FZG049

Partners

Final project report at the end of Q[12] (Deliverable D7)
Submitted by Dr. Tapas Sen (Project leader) in consultation with project partners

Nanobiomaterials Research Group (https://senlab.wordpress.com/)
Centre for Materials Science, School of Forensic and Investigative Sciences
Lead, Surface pattering group (http://www.uclan.ac.uk/research/explore/groups/surface_patterning.php)
Institute of Nanotechnology and Bioengineering
University of Central Lancashire, Preston, PR1 2HE

Due date: 31st December 2014
Actual Date: 22th January 2015

UCLAN-CHINA COLLABORATIVE PROJECT

Start date of project: 01st December 2011 Duration: 36 months

Multifunctional Nanocomposites for the Separation of Pollutants from Industrial and Municipal Sewage Water

Number of participants

University of Central Lancashire
Preston, PR1 2HE, United Kingdom

Name	Role	School	Expertise
Dr Tapas Sen	Project Leader	Forensic and Investigative Sciences	Magnetic nanocomposites and surface patterning
Dr. Tim Mercer	Collaborator	School of Computing, Engineering and Physical Sciences	Solid state physics and magnetic measurements
Prof. Glyn Morton	Collaborator	Forensic and Investigative Sciences	Microbiology

Feedwater Limited, Wirral, CH46 4TU, United Kingdom

www.feedwater.co.uk

Name	Role	Industry	Expertise
Mr Gary Hogben	Exploitation and end-user	Feedwater	Technology director for water treatment for both toxic chemicals and biochemicals

Fudan University
220 Handan Road, Shanghai China, 200433

Name	Role	Department	Expertise
Prof. D. Y. Zhao	Project Leader	Chemistry	Mesoporous solid and nanotechnology
Dr. Fan Zhang	Collaborator	Chemistry	Nanomaterials

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1. Aims and objectives

To generate biocompatible high surface area novel multifunctional porous nanocomposites with controlled pore architecture, sizes, morphology and tailored surfaces with superparamagnetic property and antimicrobial activity for dealing with the local problem of pollution (i.e. the removal of toxic chemicals from industrial pollutants and biological contaminants from municipal sewage in Shanghai) with the potential of providing a global solution to this problem and thereby creating a greener and safer environment for both developing and developed countries.

2. The specific objectives of the project and how we met during the project period (Dec'11 to Dec'14) under the contract agreement with Fudan University, China.

Objective 1- Fabrication of novel multifunctional porous magnetic nanocomposites with antimicrobial property

Status: Developed several nanocomposites with multifunctional properties and applied both for magnetic separation and antimicrobial efficiency. The developed nanocomposites are protected by RIO office of UCLan by filling patents (International PCT/GB2014/052630, 2014 & UK GB 1405617.0, 2014).

Part of the work is also published or under submission

L.Wang, L.Yang, J. Zhang, T. Sen, A. Chen, Y. Zhang, L. Shi, J. Zi, F. Zhang, and D. Y. Zhao " A Novel "Swallow-and-Spit" Route to Asymmetric Silica-Polymer Hybrid Colloids" ***Nature Communications*** (1st version completed and final preparation stage) 2015

M. Howard, J. Whittle, F. Zhang, D. Y. Zhao and **T. Sen*** "Novel Hierarchically Ordered Porous Vanado-Silicate Nanocomposites for the Application in Industrial Catalysis" " ISBN 978-1-4665-6274-5 Vol.1, **2012,** page 495-498, **CRC press, Taylor & Francis group**.

Full details also submitted as Deliverables D1 in June'12 and deliverable D4 in December 2013

Objective 2- Separation of toxic chemicals from industrial pollutant by ion exchange followed by magnetic separation

Status: Applied in separation of toxic chemicals from industrial pollutant and the results have been reported via international journal publications

L. Wang, C. Cheng, J. Lei, T. Sen, M. Matsuoka, J. Zhang, D. Y. Zhao, "Carbon Dots Modified Mesoporous Organosilica Adsorbent for the Removal of 2, 4-Dichlorophenol and Heavy Metal Ions " ***Env. Sci. Technol***. (Submitted, January 2015)

X. Yan, L. Wang, D. Qi, J. Lei, B. Shen, T. Sen* and J. Zhang* "Sensitive and Easily Recyclable Plasmonic SERS Substrate based on Ag Nanowire in Mesoporous Silica" ***RSC Advances***, 4, 57743 (2014)

L. Lu, F. Teng, **T. Sen**, D. Qi, L. Wang, J. Zhang, "Synthesis of Visible-Light Driven CrxOy-TiO2 Binary Photocatalyst Based on Hierarchical Macro-Mesoporous Silica" ***Journal of Applied Catalysis B: Environmental*** 163, 15 (2014)

Full details also submitted as Deliverable D2 in April 2013

Objective 3- Surface patterning and modification using novel surface chemistry (tri-phasic reverse emulsion) followed by surface conjugation of specific primer related to Ecoli, Legionella, Salmonella, Coliform for the separation and destruction of microorganism associated with contaminated water and inhibition of bio-film formation in stagnant industrial reservoir or water pipes

Status: The work has been completed with the success of a PhD degree awarded to Dr Ben Hodgson at UCLan in January 2014. A chapter in the PhD thesis of Dr Ben Hodgson has been published by UCLan

library.

One published and two manuscripts are under preparation solely from UCLan.

M. Eizadi-sharifabad, B. Hodgson, M. Jellite, T. Mercer, T. Sen**, "**Enzyme Immobilised Novel Core-shell Superparamagnetic Nanocomposites for Enantioselective formation of 4-(R)-hydroxycyclopent-2-en-1-(S)-acetate" ***Chemical Communications*** 50, 11185 (2014)
B. Hogdson, B. Oberhietman, T. Sen "Surface functionalization of magnetic nanoparticles with DNA primers for the detection of food –borne microorganisms" ***Langmuir*** (American Chemical Society) 2015
B. Hogdson, B. Oberhietman, T. Sen "Efficiency in detecting E-Coli in water using surface functionalized superparamagnetic nanoparticles by TPRE approach" ***Langmuir*** (American Chemical Society) 2015

Full details also submitted as Deliverables D3 in August 2013

Objective 4- Development of a proto-type for the separation of industrial pollutants (chemical and biological) for future commercialisation through the knowledge transfer unit at UCLAN and Feedwater Ltd.

Status: This work has initiated during the end of the project period but further progress is required with the help of surplus funding available (approximately £13K, see appendix, page 14) from the Fudan University budget. This is due to the absence of Fudan's postdoc to work in objective 4 for at least 6 months at UCLan in collaboration with FeedWater Ltd. UK. Hence my request is to perform the work at UCLan with the help of FeedWater Ltd. by appointing a research associate at UCLan for the period of 10 months (0.5FTE) in fix term contract in order to complete the objective. I have also submitted an Undergraduate summer internship project to work in this objective and if successful, the summer intern will work alongside research associate during the summer. It is also a part of Deliverable D6 (part B) which is yet to finish.

This work will have commercial impact as we have the patent. This will also help us to submit a Grant application to Royal Society, UK under Brian Mercer Feasibility Award in collaboration with FeedWater Ltd. which has already been agreed by Gary Hogben.

3. Deliverables

D1. A generalized protocol for the fabrication of biocompatible high surface area novel magnetic nanocomposites – M6 (**Submitted on 1st June 2012**)

D2. Novel porous nanocomposites containing SPIONs and silver nanoparticles available for separation of toxic chemicals - M12 (**Submitted in M16, May 2013**)

D3. Provision of at least 3 (tested and optimised in a model assay system) forms of novel nanocomposites surface patterned with capture oligonucleotides for use in separation of microorganism of our interest- M18 (**Submitted in M20,August 2013)**

D4. A generalised protocol for the antimicrobial activity of the nanocomposites in model assay system through CFU count – M18 (**Submitted in M24, December 2014**)

D5. A generalised protocol for the efficiency for the destruction of microorganism *via* magnetic hyperthermia route – M24 **(Continuing as a part of Royal Society Grant in collaboration with nanoscale Biomagnetics, Spain until the period of December 2018)**

D6. First versions of 'demo kits' using surface patterned novel nanocomposites for simultaneous separation of chemical and biological contaminants from water and at least one industrial sample – M30 **(Part A of the deliverable submitted in July 2014 and part B require further progress as a part of objective 4)**

D7. Final report on the efficiency and reliability of the different optimized separation protocol – M36 **(current document submitted in January 2015)**

D8. High impact journal publications, presentation of results in the International Nanotechnology Conference – M12 to M36 (Where M indicates the month) **1 GB, 1 International PCT patent application, 1 book chapter, 3 high impact journal publications, 1 journal paper submitted, 1 in submission state and 2 under preparation.**

4. Milestones
M1. Optimised protocol for the fabrication of silver nanoparticles containing magnetic porous nanocomposites (related to D1 and D2) - M12 **(completed and delivered)** **M2.** Optimised protocol for the separation of toxic chemical and microorganism from model system (related to D2 to D6) – M24 **(completed and delivered)** **M3**. Testing materials in the context of real samples from at least one industry from Shanghai – M36 **(completed and submitted the work for journal publication number 5, page 9 of the document:** L. Wang, C. Cheng, J. Lei, T. Sen, M. Matsuoka, J. Zhang, D. Y. Zhao, "Carbon Dots Modified Mesoporous Organosilica Adsorbent for the Removal of 2, 4-Dichlorophenol and Heavy Metal Ions " ***Env. Sci. Technol***. (Submitted, January 2015) see supporting information as a part of appendix for full article.

5. Final Gantt Chart received from Helen Andrew following our meeting on 13th January 2015 with project outputs

Multifunctional Nanocomposites Project timeline

Deliverables	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	Jul-12	Aug-12	Sep-12	Oct-12	Nov-12	Dec-12	Jan-13	Feb-13	Mar-13	Apr-13	May-13	Jun-13	Jul-13	Aug-13	Sep-13	Oct-13	Nov-13	Dec-13	Jan-14	Feb-14	Mar-14	Apr-14	May-14	Jun-14	Jul-14	Aug-14	Sep-14	Oct-14	Dec-14
D1: Generalised protocol for the fabrication of biocompatible high surface area novel magnetic nanocomposites	task completed																																			
D2: Novel porous nanocomposites containing SPIONs and silver nanoparticles available for separation of toxic chemicals													task extended to Mar 13				completed 6th June																			
D3: Provision of at least 3 (tested and optimised in a model assay system) forms of novel nanocomposites surface patterned with capture oligonucleotides for use in separation of microorganisim of our interest																task extended by 6 months because of delays with D2. Completed August 2013																				
D4: A generalised protocol for the antimicrobial activity of the nanocomposites in model assay system through CFU count																								completed												
D5: (not used)																																				
D6: first versions of "demo kits" using surface patterned novel nanocomposites for simultaneious separation of chemical and biological contaminants from water and at least one industrial sample																													completed	task extended within the timescale of the contract. To date top 3 materials for efficient removal of pollutants had been identified and the extension work is to consider how these can be combined into a cartridge kit						
D7: Final report on the efficiency and reliability of the different optimised separation protocol															Outputs - High impact journal publications (3 high impact papers published, 2 under review); presenation of results in the International Nanotechnology Conference; 1 UK patent followed by registration as an International Patent																				

All deliverables have been delivered and final deliverable (D7) has now been submitted as final project report

Final output

Patents

T. Sen "Antimicrobial Nanocomposites" International PCT file (PCT/GB2014/052630, 2014)
T. Sen "Antimicrobial Nanocomposites" UK patent (Ref. GB1315407.5, 2013)

Book chapter

M. Howard, J. Whittle, F. Zhang, D. Y. Zhao and **T. Sen*** "Novel Hierarchically Ordered Porous Vanado-Silicate Nanocomposites for the Application in Industrial Catalysis" " ISBN 978-1-4665-6274-5 Vol.1, **2012,** page 495-498, **CRC press, Taylor & Francis group**.

Journal publications

1. T. Sen, J. Whittle, M. Howard "Hierarchically ordered porous novel vanado-silicate catalyst for highly efficient oxidation of bulky organic molecules" ***Chemical Communications*** 48, 4232 (2012)
2. X. Yan, L. Wang, D. Qi, J. Lei, B. Shen, T. Sen and J. Zhang "Sensitive and Easily Recyclable Plasmonic SERS Substrate based on Ag Nanowire in Mesoporous Silica" ***RSC Advances***, 4, 57743 (2014)
3. L. Lu, F. Teng, T. Sen, D. Qi, L. Wang, J. Zhang, "Synthesis of Visible-Light Driven CrxOy-TiO2 Binary Photocatalyst Based on Hierarchical Macro-Mesoporous Silica" ***Journal of Applied Catalysis B: Environmental*** 163, 15 (2014)
4. M. Eizadi-sharifabad, B. Hodgson, M. Jellite, T. Mercer, T. Sen**, "**Enzyme Immobilised Novel Core-shell Superparamagnetic Nanocomposites for Enantioselective formation of 4-(R)-hydroxycyclopent-2-en-1-(S)-acetate" ***Chemical Communications*** 50, 11185 (2014)

5. L. Wang, C. Cheng, J. Lei, T. Sen, M. Matsuoka, J. Zhang, D. Y. Zhao, "Carbon Dots Modified Mesoporous Organosilica Adsorbent for the Removal of 2, 4-Dichlorophenol and Heavy Metal Ions " ***Env. Sci. Technol***. (Submitted, January 2015)
6. L.Wang, L.Yang, J. Zhang, T. Sen, A. Chen, Y. Zhang, L. Shi, J. Zi, F. Zhang, and D. Y. Zhao " A Novel "Swallow-and-Spit" Route to Asymmetric Silica-Polymer Hybrid Colloids" ***Nature Communications*** (1st version completed and final version under preparation stage) 2015
7. M Howard, J Whittle, F Zhang, DY Zhao, T Sen "Microwave assisted oxidation catalysis of bulky organic molecules using hierarchically ordered porousVanada-Silicate Nanocomposites" ***Journal of Materials Chemistry B*** (Under preparation stage), 2015
8. B. Hogdson, B. Oberhietman, T. Sen "Surface functionalization of magnetic nanoparticles with DNA primers for the detection of food –borne microorganisms" ***Langmuir*** (Under preparation stage), 2015
9. B. Hogdson, B. Oberhietman, T. Sen "Efficiency in detecting E-Coli in water using surface functionalized superparamagnetic nanoparticles by TPRE approach" ***Langmuir*** (Under preparation stage), 2015

Abstracts in International Conference proceedings:

2014

- T. Sen**, "**Recent development of surface engineering of nanoparticles in suspension for applications in biosensors for Food and Water Technology**"** International Conference on Small Science (ICSS 2014), Hong Kong, Dec. 8 to 11, 2014
- A. Kaur and T. Sen, "Extraction of toxic and valuable metal ions from used batteries and water-borne microbes from contaminated water using the multifunctional Nano composites", 4th International Conference on Nanotek & Expo, San Francisco, USA, Dec 01 to 03rd, 2014
- A. Kaur, G. Morris and T. Sen, "Hierarchically ordered porous titano-silicate with meso and microporous pore walls for the oxidation of bulkier organic molecules" 4th International Conference on Nanotek & Expo, San Francisco, USA, December 01 - 03, 2014
- M. E. Sharifabad, T. Sen, "Enantioselective desymmetrization of meso-cyclopent-2-en-1,4-diacetate to 4-(R)-hydroxycyclopent-2-en-1-(S)-acetate using enzyme immobilized superparamagnetic nanocomposites" TechConnect World Conference, National Harbor, Maryland, Washington, D.C., USA, June 16-18, 2014.

2013

- T. Sen**, "**Recent development of surface engineering of nanoparticles in suspension for applications in bio-sensors, catalysis and forensic Investigation" NanoTR9, Erzurum, Turkey, 24 to 28th June 2013
- M. E. Sharifabad1,, M. Howard1, G. Morton1, T. Mercer, L. Wang, F. Zhang, D. Zhao, G. Hogben5 and T. Sen " Multifunctional Nanocomposites in Clean Water Technology" Techconnect World Innovation & Expo at Washington DC, USA, 12th to 14th May 2013.

2012

- M. Howard, J. Whittle, F. Zhang, D. Zhao and T. Sen, "Novel Hierarchically Ordered Porous Vanado-Silicate Nanocomposites for the Application in Industrial Catalysis", Nanotech Conference & Expo, 2012 June 18-21, **2012** – Santa Clara, CA.
- B. Hodgson, B. Oberheitmann and T. Sen "Enzyme Immobilised Magnetic Nanoparticles for Bio-catalysis", International Conference on Materials and Applications for Sensors and Transducers**,** May 24-28, 2012, Budapest, Hungary.

International conferences presentation:

2015

- T. Sen**, Featured keynote speaker** on water technology in the biggest conference on Nanoscience and Nanotechnology, Techconnect World Innovation & Expo at Washington DC, USA, 14th to 17th June 2015 (http://www.techconnectworld.com/World2015/industry/EnergySustainability_Industry.html)

2014

- T. Sen**, Invited speaker** at the International Conference on Small Science (ICSS 2014), Hong Kong, Dec. 8 to 11, 2014

- **T. Sen,** Nanomaterials in water technology, 3rd Conference on "Nanotechnology in Health and Environment 2014" Shenzhen Virtual Park, China, 01st and 2nd December 2014 **(Speaker as a project leader)**
- **A. Kaur** and T. Sen, Oral Presentation, 4th International Conference on Nanotek & Expo, San Francisco, USA, Dec 01 to 03rd, 2014
- **M. E. Sharifabad** and T. Sen, Techconnect World Innovation & Expo at Washington DC, USA, 15th to 18th June 2014

2013

- T. Sen**, Invited speaker** on NanoTR9, Erzurum, Turkey, 24 to 28th June (http://www.nanotr9.org/TR/Nano_Erz_EN.aspx)
- T. Sen**, Invited keynote speaker** on water technology in the biggest conference on Nanoscience and Nanotechnology, Techconnect World Innovation & Expo at Washington DC, USA, 12th to 14th May 2013 (http://www.techconnectworld.com/Cleantech2013/sym/water_technologies.html & http://www.techconnectworld.com/Nanotech2013/bio.html).
- T. Sen**,** Nanomaterials in water technology, 2nd Conference on "Nanotechnology in Health and Environment 2013" Shenzhen Virtual Park, China, 22nd November **2013 (Keynote speaker and chaired a session as a project leader)**

2012

- **T. Sen,** "Magnetic Nanocomposites for Clean Water Technology" UCLan's International partnership conference, 20th November, 2012, Shenzhen, China (**Keynote as a project leader**)
- T. Sen, **Oral Presentation**, Nanotech Conference & Expo, 2012 June 18-21, **2012** – Santa Clara, CA.
- T. Sen**, Invited review speaker** (plenary) on bio-sensors and bio-catalysis at "International Conference on Materials and Applications for Sensors and Transducers**,** May 24-28, 2012, Budapest, Hungary. (http://www.icmast.net/index.php?option=com_content&view=article&id=76&Itemid=85)

International Conference Posters:

- A. Kaur, G. Morris and T. Sen, "Hierarchically ordered porous titano-silicate with meso and microporous pore walls for the oxidation of bulkier organic molecules" 4th International Conference on Nanotek & Expo, San Francisco, USA, December 01 - 03, 2014
- M. E. Sharifabad, T. Sen, "Enantioselective desymmetrization of meso-cyclopent-2-en-1,4-diacetate to 4-(R)-hydroxycyclopent-2-en-1-(S)-acetate using enzyme immobilized superparamagnetic nanocomposites" TechConnect World Conference, National Harbor, Maryland, Washington, D.C., USA, June 16-18, 2014.

International non-conference invited talks:

2012

- T Sen, Nanotechnology in Health, Environmental, Industrial and Forensic Sciences"; **Indian Association for the Cultivation of Science**, Calcutta, India Dec'12
- T Sen, Nanotechnology in Health and Environmental Sciences; **Tata Chemicals Ltd**, Pune, India Dec'12
- T Sen, Nanotechnology in Health, Environmental, Industrial and Forensic Sciences; **National Chemical Laboratory Innovation Hub**, Pune, India, Dec'12 (http://venturecenter.co.in/pdfs/Bio-pune-seminars-Dr-Tapas-Sen.pdf)
- T Sen, Nanotechnology in Health, Environmental, Industrial and Forensic Sciences; **Shiv Nadar University**, New Delhi, India, Dec'12
- T Sen, Nanoparticles in Clean Water Technology; **Fudan University**, Shanghai, China, May 2012
- T Sen, Follow up in the prospect of commercialisation of superparamagnetic iron oxide nanoparticles (SPIONs), **Q-Bioanalytic GmbH**, Germany, January 2012

2011

- T Sen, An overview of Nanoparticles and Nanocomposites for the application in Bioscience, **Fudan University**, Shanghai, China, November 2011

6. Long term sustainability and future prospect

The project with Fudan University initiated in December 2011 for the period of 3 years and during this period UCLan has submitted the following bids with Dr Tapas Sen as PI.

1 bid under the UKIERI programme where we introduced one academic and one industrial partner from India in addition to Feedwater Ltd. UK. The competition was very tough and only two projects (UCLan, Preston and UCL, London) from UK were awarded. This is a prestigious achievement. The project has initiated in July 2014 and will continue until June 2016.

1. 2 years (August 2014 to July 2016) collaborative research project with Peking University China, funded by Shenzhen Government, China: Total value RMB 800K of which UCLan's part is RMB300K

2 bids under the Shenzhen Government funded project. One bid was with an Industrial organisation from Shenzhen, Leveking Ltd. of totalling RMB 1.5 Million (£150K) and the other one with the rank 1 academic organisation, Peking University, China of totalling RMB800K (£80K). One project has been successful and the project has started in August 2014 and will continue until June 2016.

1. 2 years (July 2014 to June 2016) collaborative project funded by British Council, UK and Department of Science and Technology (DST), India under UK India Education and Research Initiative (UKIERI) programme in collaboration with Tata Chemicals Ltd. India and Indian Association for the Cultivation of Science, India along with Feedwater Ltd. UK: **Total value £144K** of which British council contribution of £36.2K, DST contribution of £25.8K and Industrial contribution of £82K,

4 bids to Royal Society related to the project area. Three of them under the Newton International Fellowship scheme (each £100K) and one under the Small research Grant (£15K). The small grant has been successful in 2013 in collaboration with nanoscale Biomagnetics, Spain, in connection with original deliverable D5 the project will continue until December 2018.

1. RSC instrument grant for magnetic hyperthermia**,** £14.96K as a part of a larger project (£55K) with nanoscale Biomagnetics, Spain, December 2013 to December 2018.

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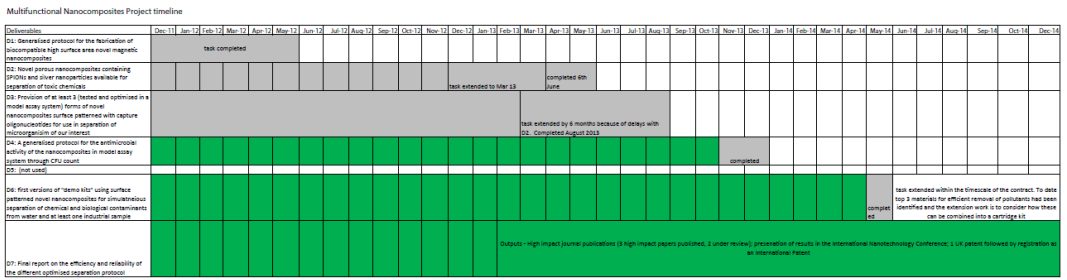
Objective 4 of the project (see page 5) which is not yet completed and a plan to meet the objective has been presented below

Original Gantt Chart



Delivered in Jan'15

Proposed Gantt chart to complete project objective 4 and part B of deliverable D6*

Task #	Task description	1	2	3	4	5	6	7	8	9	10	11	12
1	Fabrication of small scale water filtration kit using the patented materials	■	■	■	■	■	■	■	■	■			
2	Large scale production of patented materials						■	■	■	■	■	■	
3	Preparation and final submission of Royal Society Brian Mercer Feasibility Award with FeedWater Ltd. using the initial data from task 1	■	■	■	■	■	■	■					
4	Final report on objective 4												■

***Requested surplus fund of approximately £13K to hire a research associate for 10 months (Mar to Dec'15; 0.5 FTE) contract who will be helping the summer intern from June to Aug (if successful) to deliver the objective with part B of deliverable D6.**

7. Appendix

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Project budget and final balance

Project Budget:

Type	Details	True cost (£) /year	True cost (£) / whole duration of the project (including inflation)	Asking from the funder (£) / whole duration of the project (including inflation)
People	Postdoctoral fellow (CHN 110000/Year)	10370	36600 (50% will be paid by Fudan Univ)	18300
Consumables	Research expenses in China for single postdoc (CHN 67000 / year)	6280	20100	20100
Travel and subsistence	UCLAN (work related to tasks 5-9)	5000	15000	15000
	Dr Sen's visit to Shanghai (2 times in a year for the period of one week)	5000	15000	15000
	Postdoctoral fellow to work at UCLAN for the period of six months during the 2nd year of the project including travel	12100	12100	12100
	Prof. Zhao's visit (twice) to UCLAN	3500	3500	3500
	International conference presentation	2000	6000	6000
	Grand Total		**108300**	**90000**

Salary + consumable for Fudan: £38400 i.e. £3200 / Quarter
Travel for postdoc and stay at UK: £12100
Travel for Prof. Zhao's visit: £3500

Invoices raised and paid to Fudan University and the amount unpaid as surplus amount

		£	RMB
Quarter 1		£2,866.25	29000
Quarter 2		£3,533.75	35000
Quarter 3		£3,200.00	32000
Quarter 4		£3,200.00	32000
Quarter 5		£3,200.00	32000
Quarter 6		£3,200.00	32000
Quarter 7		£3,200.00	32000
Quarter 8		£3,200.00	32000
Quarter 9		£3,200.00	32000
Quarter 10		£3,200.00	32000
Quarter 11		£3,200.00	32000
Quarter 12		£3,200.00	32000
	Travel budget to be invoiced in Consultation £12100 (Lingzhi's stay) +£3500 (prof. Zhao's 2 visit)	£15,600.00	
TOTAL		£54,000.00	

Paid Quarterly to Fudan University with my approval

Unpaid amount of approximately £13K from the travel budget

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Financial Statement of code FZG049 (UCLan's part)

Year	Total budget for UCLan's part (£)				Total spent	Total balance	
	Consumable	Travel	Conference	Total			
1 (Dec'11 to Nov'12)	5000	5000	2000	12000	Until 15/10/12 5890.36 15/10/12 to 30/11/12 1211.83	4897.81	Unspent
2 (Dec'12 to Nov'13)	5000	5000	2000	12000	01/12/12 to till todate 1466.48	10533.52	Unspent
3 (Dec'13 to Nov'14)	5000	5000	2000	12000			No account

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Deliverables (D1 to D4 and D6): See attached as zip folder

Patents and published and submitted book Chapter and Journal publications: see attached as zip folder