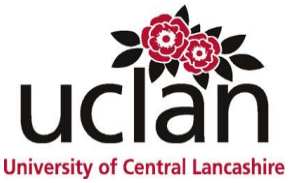
ROYAL SOCIETY RESEARCH GRANT (REF. RG130367)

Project title: Localised heating of core-shell superparamagnetic iron oxide nanoparticles under magnetic hyperthermia for applications in catalysis, drug delivery and water purification

Report submitted by

Dr Tapas Sen, PhD, MRSC, FHEA
Senior Lecturer, Course Leader MSc Chemistry
Centre for Materials Science
School of Forensic and Investigative Sciences
http://www.uclan.ac.uk/schools/forensic_investigative/sci_fz_tapassen.php

Research Lead, Nanobiomaterials Research Group (https://senlab.wordpress.com/)
University of Central Lancashire
Preston PR1 9HW
United Kingdom
Tel: +44(0)1772894371, Fax: +44(0)1772894981
Email: tsen@uclan.ac.uk



ROYAL SOCIETY RESEARCH GRANT (REF. RG130367)

Original aim of the project: The proposed work involves a localised heating of magnetic nanoparticles with surface functional groups (such as enzymes, DNA primers and drugs) using a commercially available magnetic hyperthermia kit.

Research outcome: We have purchased a state of the art hyperthermia facilities (DM100 Series: one DCM1 System controller and one DM2 Applicator and accessories) from nanoscale bio-magnetics SL, Spain and used for the following experiments:

1. We have tested two types of superparamagnetic iron oxide nanoparticles (SPIONs) with different shapes (rhombic and spherical) and sizes (10 nm to 200nm) before coating with silica (amorphous and mesoporous).
2. The materials were then used for the immobilization of enzymes and used them for hydrolysis of p-nitrophenyl palmitate under the condition of normal heating and hyperthermia heating.

Figure 1a presents the heating ability of SPIONs and figure 1b presents the efficiency of catalysis. The novel results are in the process of communicating in Chem. Commun. (RSC journal)

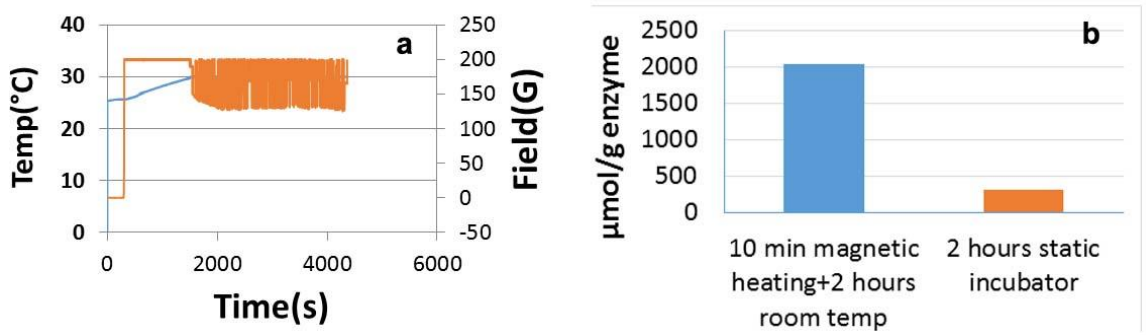


Figure 1a: magnetic heating efficiency; Figure 1b: Catalytic efficiency in magnetic hyperthermia against normal heating (Results are confidential and under preparation for Chem. Commun.)

Number of people involved in the work: 1 PhD student, 2 MChem Students along with PI (Dr Tapas Sen and CoI (Dr. Tim Mercer)

Publications:

M. E. Sharifabad, T. Mercer, T. Sen, "The fabrication and characterization of stable core-shell superparamagnetic nanocomposites for potential application in drug delivery" ***Journal of Applied Physics*** **2015** (in press)

M. E. Sharifabad, T. Mercer, T. Sen, "Highly efficient catalysis using enzyme immobilised magnetic nanoparticles under AC magnetic field" ***Chemical Communications 2015*** (under preparation)

Conferences:

Y. Patil-Sen, M. E. Sharifabad, T. Mercer, G. Bond and T. Sen "Thermally responsive lipid coated superparamagnetic nanoparticles for frequency triggered drug delivery" Tech Connect World Innovation Conference & Expo, Washington DC, USA, June 14-17, 2015

Continuation and future prospect

This grant has been highly appreciated by the University of Central Lancashire (UCLan) and came to an agreement with nanoscale biomagnetics SL, Spain for 5 years collaboration where Royal society's contribution is £14916.5 along with UCLan's contribution £23800 and nanoscale biomagnetics SL (discount £12688.5) as per the collaborative agreement to purchase the best equipment in the market.



(http://www.nbnanoscale.com/DM100-Series-instruments-for-magnetic-hyperthermia.html)

UCLan has also supported a postdoctoral fellow (Dr. Yogita Patil-Sen) for 6 months (0.5 FTE, 1st March to 31st August 2015) to work under collaborative agreement followed by the possibility to continue further 2 years under Daphne Jackson Foundation Grant.

ROYAL SOCIETY RESEARCH GRANT (REF. RG130367)

Financial statement:

Period	Project	Account	TransNo	Doc. Date	Description	Amount	Expenditure Type.
201306	FZX099	6001	1485010	09/01/2014	BIB F CHAPS 07.01.14 - NANOSCALE BIOMAGNETICS - 1ST INSTALLMENT DEC 13 - INVOICE 2013/13	14,916.50	Equipment
201313	FZX099	6472	1510729	12/08/2014	transfer surplus from FZX099 to FZB001	43.50	Balance moved to school to pay second Invoice
201306	FZX099	8201	1486647	21/01/2014	THE ROYAL SOCIETY BS 18.12.2013 tran 1484284 correction	-14,960.00	Income

SCHOOL OF Forensic and Investigative Science

CODE:	FZX099	TITLE:	Re-Submission - Localised heating of SPIONs and porous
Funding Body:	Royal Society	PI:	T Sen
FINANCIAL YEAR: 2012/13			
Start Date:	01/11/2013	End Date:	31/10/2014
STATUS:	ACTIVE		
Period 7 - February 2014			

	pFACT	Actual	Committed	Forecast	Total
Income	-	(14,960)	-	-	(14,960)
Expenditure	14,960	14,917	-	-	14,917
PROJECT BALANCE - Deficit / (Surplus)	14,960	(44)	-	-	(44)

INCOME				Account Code	pFACT	Actual	Committed	Forecast	Total	P
Date	Reference	Received from	Narrative		Gross	Gross	Gross	Gross	Gross	
			income	8201		(14,960)			(14,960)	6
TOTAL INCOME					-	(14,960)	-	-	(14,960)	

EXPENDITURE				Account Code	pFACT	Actual	Committed	Forecast	Total	P
Date	Reference	Name / Supplier Name	Destination / Narrative		Gross	Gross	Gross	Gross	Gross	
Staffing										
Sub-total					-	-	-	-	-	
Equipment										
24/12/13	3315866	Nanoscale Biomagnetics	Magnetic Hyperthermia Instal 1 laptop	6001	14,560 400	14,917			14,917	
Sub-total					14,960	14,917	-	-	14,917	
Other costs										
Sub-total					-	-	-	-	-	
Travel										
Sub-total					-	-	-	-	-	
OVERHEAD										
Sub-total					-	-	-	-	-	
TOTAL EXPENDITURE					14,960	14,917	-	-	14,917	

Notes:

1. Template used for projects opened & closed within 1 financial year
2. A commitment is an order generated or where there is a known or firm intention to spend (ie staff cost)
3. A forecast is likely expenditure based on School spending plans or future anticipated costs