

### Job Description

Post Title and Post Number	<b>Research Fellow in DNA Chemistry - 43353</b>
Organisation Advertising Description	School of Chemistry
Post Number	43353
Full Time/Part Time	Full Time
Duration of post	54 months
Post is open to:	Internal and External Candidates
Grade	Grade 7
Salary	Starting salary of £27,183 a year, in the range of £27,183 to £35,469 a year (potential progression on performance once in post to £37,651)
Additional Information	Informal enquiries can be made to Dr Jim Tucker via email to <a href="mailto:j.tucker@bham.ac.uk">j.tucker@bham.ac.uk</a> Post is available from 1 January 2009 or as soon as possible thereafter and is currently funded for 54 months, with a possible maximum duration of 5 years subject to availability of funds.
Terms and Conditions	<a href="#"><u>Research and Analogous Staff (non-clinical)</u></a>
Closing Date	5 December 2008

### Project Details

The project forms part of the current interest in the synthesis and control of nanoscale objects and comes from the award of a five-year EPSRC Leadership Fellowship to Dr Jim Tucker, entitled "Functional DNA-based Assemblies". The fellowship involves a multi-disciplinary collaboration involving scientists in the UK (e.g. University of Birmingham, University of Warwick and Queen's University Belfast) and abroad (University of Bordeaux).

The work will involve the design, synthesis and study of modified DNA, where a non-natural monomer is incorporated into DNA through automated synthesis at an appropriate position of the chain. Modifications will lead to novel functions and uses being brought to DNA, by virtue of it being given photo-active and redox-active properties. The expertise of the Tucker research group in functional supramolecular systems will allow various novel light-driven or redox-driven processes to control (or be controlled by) the polymeric structure.

Major themes of the project are outlined below:

(i) DNA sensing: Certain mismatches in the DNA base sequence of the human genome, called single nucleotide polymorphisms (SNPs or “snips”) are indicative of a pre-disposition to certain genetic diseases. Our initial studies have indicated that certain SNPs in short strands of DNA can be detected through changes in the emissive response from a DNA probe tagged with an anthracene group (see: Chem Commun, 2006, 5003). A significant proportion of the project will be spent rationalising and optimising these results by using and studying various modifications to monomer units through various techniques (e.g. UV/vis, NMR and CD spectroscopy). Surface-immobilised versions of these DNA probes will also be prepared and duplex formation and sensing signals studied and optimised.

(ii) Photochromic DNA: The introduction of photochromic groups into nucleic acids would allow DNA structure and function to be controlled by light. The part of the project (in collaboration with Dr Dario Bassani at the University of Bordeaux) will explore the effect of tagging various nucleic acids (including cyclic aptamers) with two anthracene units, allowing anthracene photo-dimers to form upon light irradiation. For previous work by the Tucker group on anthracene photochromism, see: Angew. Chemie. Int. Ed. 2005, 44, 1072)

(iii) Redox-active DNA: The project will explore different approaches to the incorporation of metallocene units (e.g. ferrocene derivatives) into nucleic acids, with the aim of controlling duplex stability and developing DNA sensors through electrochemical methods. For recent work by the Tucker group on ferrocene-based electrochemical sensors, see: J. Org. Chem. 2008, 73, 1225.

In total, two postdoctoral research positions and at least two other PhD studentships will be allocated to this project. This post provides the backbone to the fellowship and will be filled by a researcher with a background in nucleic acid chemistry and with particular expertise in their preparation and study using various spectroscopic and analytical techniques. Ideally the fellow will also have experience of surface immobilisation and characterisation techniques (e.g. SAM chemistry, microscopy) and have experience of computational modelling, photochemistry and/or electrochemistry.

A majority of the studies will be conducted at the University of Birmingham (Grade 5 in 2001 RAE) under the supervision of Dr Jim Tucker. Automated DNA synthesis will be done in collaboration with the research group of Dr Joe Vyle (Queen's University Belfast). Birmingham Chemistry is undergoing a refurbishment programme to produce state-of-the-art laboratories. The Research Fellow will have their own bench space, along with a separate office space with direct access to a comprehensive range of electronic library resources. An excellent range of instrumentation is available within the School. Its Centre for Chemical and Biochemical Analysis has dedicated MS, HPLC, X-ray crystallography and NMR laboratories and possesses a comprehensive range of modern instruments supported by dedicated support staff. NMR spectrometers include 1 x 500, 2 x 400, and 2 x 300 MHz machines. In addition, the project has access to very high field (e.g. 900 MHz) machines at the University of Birmingham's Biomolecular NMR facility (see: <http://www.nmr.bham.ac.uk/>) and to circular/linear dichroism facilities in the School of Chemistry and elsewhere on campus.

### **Role Purpose**

To contribute to the achievement of the School's research strategy by undertaking specified research activities within an established research programme.

## **Main Responsibilities**

- To undertake research relating to the study of a range of DNA-based constructs under the supervision of Dr Jim Tucker. This will include the following: -
  - Synthesis of modified DNA and relevant monomeric precursors for solution and surface studies
  - Characterisation of modified DNA using various spectroscopic and analytical techniques
  - Carrying out DNA binding experiments, including photochemical and electrochemical studies
  - Some design and modelling work on DNA-based systems as required
- Liaise and interact with other members of the DNA project team based at Birmingham and in other institutions (Warwick, Belfast, Bordeaux). The nature of the collaborations will require regular exchanges of information and materials. Some travel will be required.
- Assist with the supervision of less experienced members of the Tucker group working in related areas, including providing guidance to other staff and students on own specialist area
- Assist with the day to day running of the Tucker laboratory, including taking responsibility for training and maintenance of specific items of laboratory equipment.
- To plan and develop research contributions to subject area using methodologies, critical evaluations, interpretations, analyses and other appropriate techniques
- To contribute to writing bids for research grants
- To suggest and contribute to the development of research techniques, models and methods in collaboration with colleagues
- To disseminate research findings using appropriate and effective media such as publication, research seminars etc
- To contribute to the production of research reports and publications
- To prepare papers for Steering groups and other bodies
- To analyse and interpret the results of own research and generate ideas based on outcomes

## **Knowledge, Skills, Qualifications and Experience Required**

### **Essential**

- First degree in Chemistry or a closely related discipline;
- Completed, or near completion of, a PhD in Chemistry or a related discipline;
- Expertise in chemical techniques relevant to nucleic acid chemistry (e.g. organic synthesis and synthesis using automated methods, spectroscopic and analytical techniques for its characterisation);
- Excellent communication, interpersonal and presentation skills and an ability to work as part of a multi-disciplinary team.

### **Desirable**

- Experience in using various spectroscopic and analytical methods for studying oligonucleotide binding interactions;
- Experience in physicochemical techniques such as luminescence spectroscopy and electrochemistry;
- Experience in the study and characterisation of surface-immobilised molecules using various techniques;
- Knowledge of computational modelling techniques and associated software packages