EPSRC Centre for innovative manufacturing in ultra precision

CDT-UP Newsletter

Centre for Doctoral Training in Ultra Precision Engineering

December 2014

Welcome to the first edition of the CDT-UP Quarterly Newsletter!

Jason Ten Wins MRes Award

Congratulations to Jason Ten for being awarded the Student Excellence Award for his outstanding performance during 2013 - 14. Jason was presented with a £100 Amazon gift voucher.

Recruitment – 30 June 2015 Deadline

The CDT-UP is currently recruiting students interested in an MRes & PhD in Ultra Precision Engineering to begin in October 2015. Students can either apply at Cambridge or Cranfield University depending on their choice of topic.

Long Project request

If you'd like to offer a long project, under the Ultra Precision heading, to one of our current MRes students please email Sophie Fuller, sg523@cam.ac.uk, with the details of this. The students begin their projects in April and these run up until the 28 August 2015.

Industry Tour 2014

Our MRes students took part in an industry tour at the beginning of December. The first leg of the tour started on the 4th December where they attended presentations and toured the facilities at Zeiss, Airbus Defence and Space and NPL. The 2nd part of the tour took them to Oxford & Gloucester where they visited a further 6 companies over a 3 day period (Integration Technology Europe, M-Solv, Oxford Instruments, Renishaw, Rutherford Appleton Laboratory and finally Michell Instruments). Our students were particularly impressed by the modern facilities, the enormous range of high tech products and the significant work undetaken on such a wide range of fields. A great time was had by all!

The Diamond particle accelerator at Rutherford Appleton Laboratory

Cranfield UNIVERSITY

UNIVERSITY OF CAMBRIDGE

Project Feature: Production of carbon nanotube based cold field emission cathodes. By Francisco Orozco

Background
Cold and thermionic are types of electron emission and may be applied as emission sources for X-ray systems, electron beams, displays and lamps. Thermionic field emission has inefficient power utilisation, poor reliability and an inadequate lifetime attributed to the high temperatures required for electrons to go over the work function. Cold emission is more energy efficient due to the bending of the work function which allows electrons to tunnel through.

Summary
The programme investigates the application and development of carbon nanotubes (CNT's) as cold cathodes. CNT's show high aspect ratio, high current carrying capacities, are chemically inert and can be produced in large quantities. The CNT films and fibres are machined by a laser source producing geometries favourable for emission. Figures 1 and 2 show the improvement of a laser cut fibre over mechanical cut.

This project has three research strands:
- Optimizing emission characteristics, increased emission current and reducing turn-on voltage. Early success has indicated significant emission benefits when the material is processed using an ultra-fast laser [1].
- Development of a scalable production route overcoming key difficulties for production such as handling the material. Films are around 30-50 µm thick and the fibres around 10-30 µm in diameter. The material is susceptible to environmental (i.e. small currents of air, moisture) and electrostatic forces. These materials are also non-uniform in dimensions, mechanical and electrical properties making uniform batch processing a challenge.
- Production of 2D and 3D arrays for increased current capacity.

The manufactured samples are characterized and evaluated at the Air Force Research Laboratory Materials and Manufacturing Directorate.

Publications
[1] Steven B. Fairchild, John S. Bulmer, Martin Sparkes, John Boeckl, Marc Cahay, Tyson Back, P. Terrence Murray, Gregg Gruen, Matthew Lange, Nathaniel P. Lockwood, Francisco Orozco, William O'Neill, Catharina Paukner and Krzysztof K. K. Koziol. "Field emission from laser cut CNT fibers and films." Journal of Materials Research, Volume 29, Issue 03 2014, pp392-402.

[2] M. Cahay, P. T. Murray, T. C. Back, S. Fairchild, J. Boeckl, J. Bulmer, K. K. K. Koziol, G. Gruen, M. Sparkes, F. Orozco and W. O'Neill. Hysteresis during field emission from chemical vapor deposition synthesized carbon nanotube fibers external link. Appl. Phys. Lett. 105, 173107 (2014).

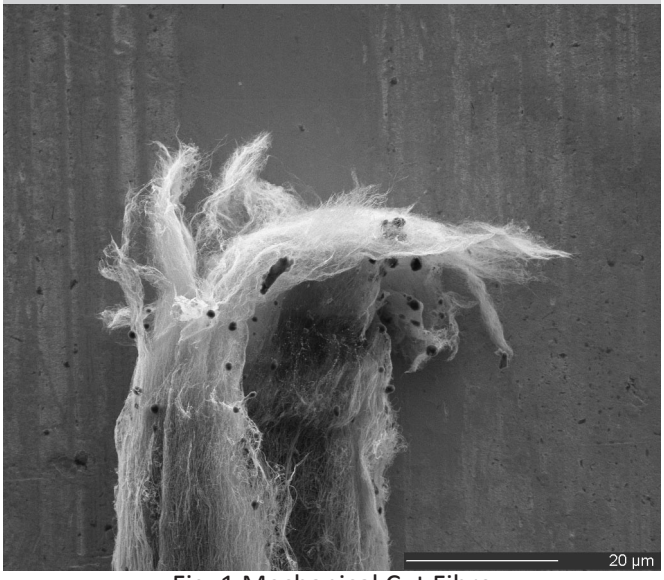

Fig. 1 Mechanical Cut Fibre

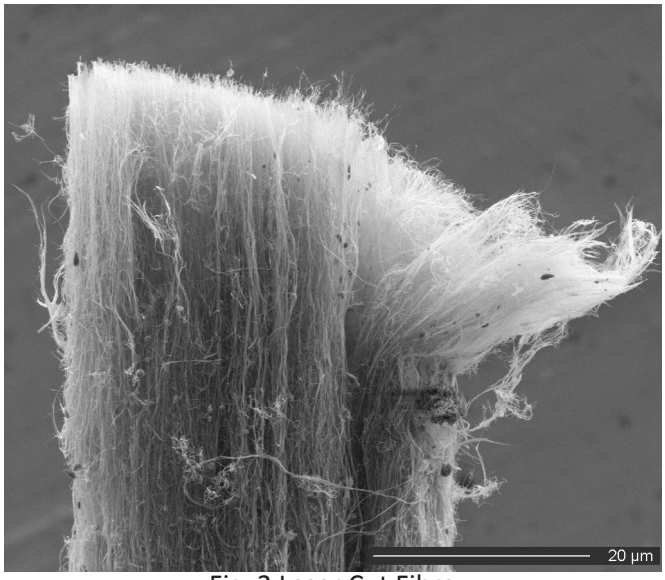

Fig. 2 Laser Cut Fibre

Save the Date - the 2015 Science Festival takes place on the 21 March & the CDT MRes student led conference on the 12 May 2015, both taking place at the IfM

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