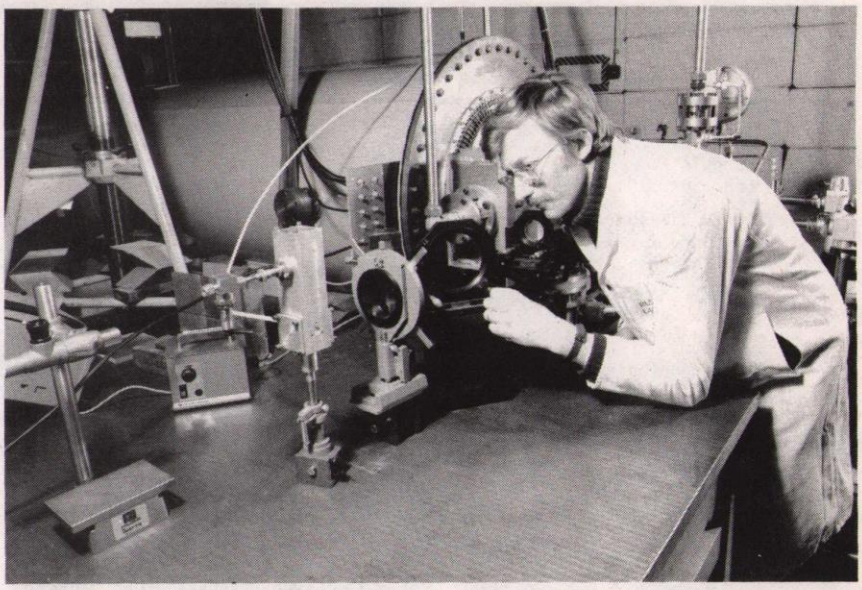
Bulletin
of the Rutherford Appleton Laboratory 25 Jan 1982 No.2

Laser Annealing with ELF

For the first time, manganese doped films of zinc sulphide (ZnS), a promising material for the fabrication of large luminescent displays, have been laser annealed using the Laboratory's electron-beam pumped excimer laser system, ELF. In a short series of experiments by RAL in collaboration with the University of Bradford, the luminescence efficiency of such films has been improved by a factor of two over more conventional thermal annealing processes. This was achieved using 308nm radiation from the xenon chloride exciplex laser system.

Thick films of zinc sulphide are already finding applications in some commercial displays, but problems of short lifetime, a relatively poor visibility under daylight conditions and the requirement of large drive voltages (about 150 volts) limits their widespread use. It is believed that thin films, on a silicon substrate, would offer advantages of extended lifetime, exhibit significantly increased brightness and need lower voltages.



Laser radiation from ELF is focussed into the high pressure vessel (the rectangular chamber left of centre) containing semiconductor samples to be annealed. 37688

Why Laser Annealing ?

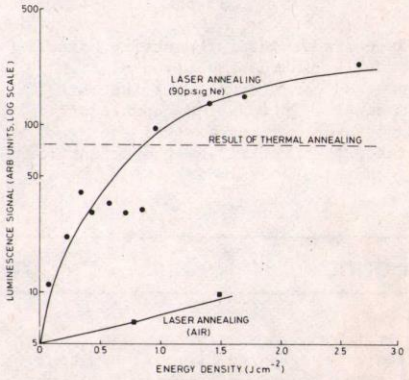
In order to produce an electro-luminescent device, it is necessary to modify the physical characteristics of the surface layer of the zinc sulphide by the introduction of a dopant, (in this case manganese) at concentrations of about 0.3 atomic % to a depth of 200nm. This is done most conveniently for research purposes by high energy ion-implantation techniques which give a well controlled implant depth of Gaussian profile. This procedure causes damage to the crystal structure of the material and results in manganese atoms being positioned interstitially in the zinc sulphide crystal lattice. Conventional thermal treatment suffers from problems associated with dopant segregation and damage to the films at the high temperatures required (about 700^{o}K) over the annealing time. With laser annealing, however, it is thought that the material is subjected to momentary local melting of the damaged crystal, followed by epitaxial regrowth of the crystal from underlying undamaged material, resulting in a high activation of the manganese in substitutional lattice sites. The laser wavelength required is determined by the band gap of zinc sulphide; a photon wavelength greater than about 350nm is not absorbed and consequently heating of the material cannot occur; the xenon chloride wavelength of 308nm is well suited to the annealing requirement.

Solution to a Problem

Previous attempts to anneal ZnS at this and other laboratories proved unsuccessful due to the relatively low damage threshold at 308nm (200mJcm^{-2}). This is probably due to the absence of a liquid phase in ZnS at atmospheric pressure. The solution to the problem was to use an atmosphere of inert gas (neon) at high pressure (100 psig) enabling laser energy densities of up to 3Jcm^{-2} to be used without damage. Under these conditions the luminescence signal (shown in the graph as a function of laser energy density) was found to be in excess of twice that observed with thermal annealing, whilst untreated specimens exhibited no luminescence. In addition increased crystallinity is observed by electron microscopy. Further studies of the annealed samples are being performed using the Rutherford Back-Scattering facility at Surrey University.

Future experiments planned include the optimisation of the annealing process over a range of dopant concentrations and a study of photolytic depositions of manganese onto the ZnS with subsequent annealing using a single laser pulse.

For further information contact Chris Edwards, RAL or Dr H S Reehal, University of Bradford.



Plot of luminescence as a function of laser energy density

INTERNAL Events

ASTROPHYSICS SEMINARS
R61 CONF.ROOM - 1400hrs

27 Jan: "IRAS" part of a series by Jack Abolins of the IRAS Control Centre - RAL

3 Feb: Pat T Wallace/RAL
"Computer Control of the Anglo-Australian Telescope"

CONDENSED MATTER SCIENCE SEMINARS
R3 CONF.ROOM - 0930hrs

26 Jan: G R Luckhurst/Southampton
"Order in Liquid Crystals Experiment and Theory"

2 Feb: J Q Broughton/Bell Telephones
"Structure Dynamics and Thermodynamics of the Crystal-Liquid and Crystal-Vapour Surface Systems"

HEP TECHNIQUES SEMINAR
R61 CONF.ROOM - 1400hrs

4 Feb: Dr J Malos/Bristol
"Seeing Single Quanta"

EXTERNAL Events

PHYSICS COLLOQUIA
CLARENDON LAB - OXFORD - 1615hrs

22 Jan: Prof H Faissner/RWTH, Aachen
"Evidence for a Light Penetrating Boson"

29 Jan: Prof E L Hahn/Berkeley
"The Ebb and Flow (echo phenomena) of Atomic Chaos"

5 Feb: Prof E Adelberger/Washington
"Fundamental Symmetries in Nuclei"

ELEM.PART.PHYS.SEMINARS
NPL - OXFORD - 1430hrs

27 Jan: Dr Ken Heller/Minnesota
"The Soudan I Nucleon Decay Experiment"

THEO.PHYS.SEMINARS
TPD - HARWELL - 1400hrs

26 Jan: Prof V Heine/Cambridge
"Modern Developments in the Theory of Itinerant Electron Magnetism"

2 Feb: Prof J Hasted/Birkbeck
"Paranormal Phenomena"

SHEP SEMINARS
SOUTHAMPTON - 1430hrs

29 Jan: H Osborn/DAMPT
"Application of Semiclassical Methods to Monopole Solutions"

5 Feb: E Corrigan/Durham
"Multi-monopole Solutions in Spontaneously Broken SU(2) Gauge Theories"

PART.PHYS.DISC.GP MEETINGS
BIRMINGHAM - 1615hrs

27 Jan: Dr M Jobes/Birmingham
1400hrs "Photoproduction of Charm at 20 GeV"

29 Jan: Dr J Ellis/CERN
"Grand Unified Theories"

5 Feb: Dr A Segar/Oxford
"Results from the CCOR Solenoid Experiment at the ISR"

HIGH POWERED PERSONAL COMPUTERS
by
Prof F R A Hopgood

Lecture Theatre - Thursday 4 February
3.15 pm

Recent advances in computing hardware have led to the evolution of high powered computer systems that are moderately prices and capable of providing a large part of the resources required by the scientific computer professional.

Found

A silver coloured cigarette lighter has been found in the Main Car Park. For information please ring Ext 410, or call at Room 5, R20.

Speech Recognition Workshop

A one-day speech recognition workshop is to be held at the Rutherford Appleton Laboratory in the near future. Included in the programme is a demonstration of the LOGICA speech recogniser, LOGOS.

Would anyone who wishes to attend please write to: Dr I D Benest, Rutherford Appleton Laboratory, Atlas Centre, Chilton, DIDCOT, Oxon, OX11 0QX for an application form.

Film Badge Notice

It is Period 1 Colour Strip BLUE.

Please check that you are wearing the correct film and all old ones are returned. Anyone requiring a new holder please phone Jenny Coates Ext. 430.

Next Film Change

Monday 1 February.

Rutherford Medal 1982

Our congratulations to Dr D M Brink, FRS, of Oxford University, who has been awarded the Rutherford Prize and Medal for 1982 by the Institute of Physics, "for his contributions to the understanding of nuclear structure and nuclear reactions". Dr Brink is a member of the SERC Nuclear Physics Board's Nuclear Structure Committee and Nuclear Physics Sub-Committee.

Library Notice

Do you have any spare copies of the RAL Annual Report for 1980? If so, the Library R61 would be very grateful to receive a few copies as we have completely run out!

Diary of a Blizzard

Norman Goddard, Alf Brown (centre), Dave MacAndrew (in cab), Tony Addison and Martin Herbert with the overworked snowplough. (82RB1151)

Friday pm - Saturday am

Called out! Had to walk from Rowstock - on the way up absolute chaos, cars and lorries stuck in the show, drifts approx 2ft deep, snowing very hard and blowing from East to West. Buses being turned into Harwell main gate, they have decided not to try to get to their destination, conditions were so bad. Arrived at site, collected the snow-plough and found that most roads on site were blocked or partially blocked both with snow and abandoned cars, - cleared what was possible. (Cars stopped all roads being cleared). Started on runway (Fermi Avenue), again made more difficult by abandoned cars. Forced our way through the South exit (by prefabs), main road still blocked with cars and lorries (being turned off by-pass?). Back to site, roads that have just been cleared almost blocked again. Security have located car owners that have abandoned cars by R22 and R20 areas, clear a passage into Car Park to get them off the road, cleared site again back to runway, only one lane clear of snow. Main A34 still blocked, push the snow to one side and tow a lorry out and he parks out of the way in Fermi, he decides to walk home to Wantage (he must be mad!). Other cars and lorries eventually get moved out of the way - head South on A34 one lane only - back in South gate and down Fermi Avenue, two lanes open again - round site, roads closing again. Back to Atlas through to Bus Park to allow people and vehicles to get to Harwell canteen used as a hostel. Up to A34, turn North - road in terrible condition, only one lane (just). Vehicles abandoned everywhere - force our way to North Drive, the road is closing behind us - taxi abandoned in middle of the road, cars that we have managed to weave round are following us through end of houses, open fields both sides, drift must be 3 foot deep now - down to Rowstock and back South, about 30 cars must have followed us through - another car left in middle of the road by bungalow - cars following again, road impassable so force our way back - difficult, someone else has left a car near the taxi - back into Fermi, left hand side of island blocked - clear that and make our way back - drifting across runway again - into site and clear the roads again. Blowing a gale now, conditions getting a lot worse - back to A34, more traffic jammed so head towards Rowstock, by the look of it nobody had been down that road and yet it was only about 2 hours since we cleared it - met a Council lorry with snowplough blade about a foot in the air stuck fast - offer to give him a tow but he keeps struggling, eventually gets out, don't see him again. Back to site from Rowstock, drifting still, snowing harder than ever - clear site (snow-plough width) back to A34 about 4am. Meet snow blower from RAF Abingdon broken down by Fermi entrance. Another Council snowplough tries to pass, gets stuck, accepts help, disappears. We head for Rowstock, blower doing a great job, 1½ lanes open, back to Fermi. Carry on to Chilton roundabout, not too bad on the bridge in South. Clear the roads back down Fermi and follow blower to Rowstock, roads looking pretty good now, RAF boys have to go back to base to clear their runway by 7am. Clear site heading back to A34 - while moving round abandoned car hit the kerb at the end of runway, broken frame of snowplough, up to R18 where Fred Knott straightens the frame, and welded the broken parts, he does a marvellous job, considering the condition it was in! Take Fred to the buses, suggest they hold the buses until we get back - clear the bus exit - buses ready to roll, so they follow us through to Rowstock. All get through OK, but how they missed the taxi heaven knows. Conditions getting better now but still drifting.

Saturday

Now back down A34 to clear road for shift workers, still bad, see another snowplough, a different one, he's doing a better job, but the blades too small for these conditions so he's getting a lot of overspill - meet him again and suggested that he follows me and clears my overspill.

Saturday pm - Sunday am

Back to site and runway, you just have to keep going to keep it open! The wind has changed direction now so the drifts are all in different places and blowing the snow that we have pushed back, onto the road again, just as we thought we had it licked! So, keep going round and round until change of shift. Back down to Rowstock, the wind change has helped a bit, decide that we will force the snow back to allow more passing places. AERE snowploughs out in force, decide that we'll all try and make it wider along the whole length - winning slowly but surely - taxi driver arrives to get his car out - much better now with him out of the way. Back to base for a couple of hours shut eye. Out on the A34 for 6-2 shift workers - Council lorries everywhere putting salt down on about 18 inches of snow. Council driver gives me a row for pushing the snow off the road as his Magic Salt will do the trick, so decide to return to site.

Start to clear Car Park - going well, about three blades width each side, touched an island and the tie rod broke. R18 arranges for a welder to be brought in to repair it. Fred Knott arrives and fixed it again - back to Car Park and finish that off - R20 next, started it then Norman and Martin took over!

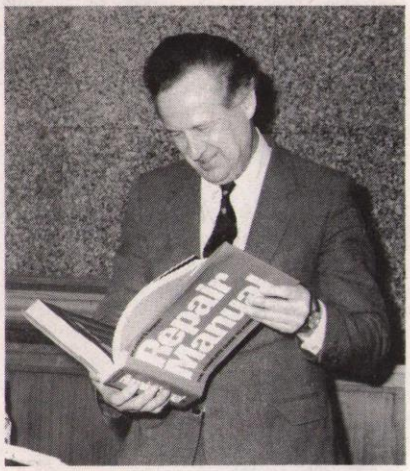
Missing

A Rectilinear Potentiometer type LP21/85/5, last seen in Lab 3, R1, before "the big move". Please contact Derek Cragg, R65, Ext 6620, if you have seen it.

From R3 Conf. Rm. a Kodak Carousel Slide Projector. Please contact J Wheeler Ext 6115

Three telephone hand-sets are missing from R5.5 (SNS Control Centre). Please contact Jack Wheeler, R2, if you know where these can be found.

Goodbye David - Goodluck



82RB1145

David Harrison obviously meant to start the New Year well - on 31 December 1981 he retired!

David joined the Lab in 1960 after a varied career as resident engineer on projects that included harbour installation in Cornwall and bridge building in Sierre Leone. In 1972 the SRC Council Works Unit was formed and David helped set it up and established procedures.

Roy Tolcher, making the presentation, looked back on the successful outcome of the projects they had worked on together. David had had a hand in conversions of SRC offices in Holborn and Oxford Street, London, in the conversion of the Old Spring Workshop at British Rail, Swindon, the construction of the Photographic building at Ditton Park, and many other various projects throughout the SERC.

"My own most lasting memories of David will be associated with the Millimetre Wave Telescope and visits to Madrid, Tenerife and La Palma," said Roy, "In particular of driving down the mountain after a long day's work and hitting a rut in the track we were on. We had a sheer wall on one side, a sheer drop on the other and a wheel damaged to such an extent it wouldn't turn. The action taken displayed to the full David's resourcefullness - and here's a photograph to prove it!".

David was then presented with the photo, a Peter Bradley card (without which no EBW farewell is complete), a Benchmate, a Propogator, the RAL presentation tray, and a hint of things to come - Do it yourself household hints!

In reply, David thanked everyone for their kind words, the generous gifts, and the friendship of many years.

Music for Pleasure

Tickets for a series of concerts at the Albert Hall, given by The London Philharmonic Orchestra, can be obtained at reasonable prices from N G Angold, Ext 6508.

The next concerts will be on Fridays, 19 and 26 March, at 7.45pm. The programme will be the same on both evenings.

Nicolai - Overture, The Merry Wives of Windsor.

Tchaikovsky - Piano Concerto No 1.

Brahms - Symphony 2 in D.

Booking closes on 8 February.

Thankyou All

The snow and blizzards of Friday 8 January that caused chaos over the rest of the country didn't do much for RAL either. From 3 o'clock that afternoon until Monday afternoon members of the Heavy Gang fought, what seemed at times to be, a losing battle with the elements.

Three times the AERE buses tried to reach Rowstock and three times they returned. Only with the efforts of Dave MacAndrew and Tony Addison who worked Friday evening to Sunday morning clearing the site, Fermi Avenue, and eventually the main road to Rowstock (early on Saturday morning) was it possible for the hundreds of stranded RAL and AERE staff to get home. The exchange shift of Norman Goddard and Martin Herbert somehow managed to get here and continued the work from Sunday morning to Monday afternoon and RAL was open for business again.

The catering staff too, rose to the occasion, providing food for all on Friday night. Some of them being on site until the morning.

The Security Wardens, faced with an influx of calls from frantic relatives dispensed comfort and information, and organised the chaos, working double shifts until Sunday morning.

Tudor Morgan, Pat O'Connor and Brian Prior saw that everyone was kept warm during the long night, Pat being on site for 32 hours. Fred Knott, with some assistance from Brian Prior, spent Saturday and Sunday morning welding the snow plough and keeping it running.

Indeed many helpful acts were performed by people who can only be thanked, together with those who have been named, by means of this appreciation from us all.

RAL Table Tennis

With the start of a new year the Rutherford Appleton Laboratory (RAL) Table Tennis Club can reflect on a quite successful first half of the 81/82 evening league season and I hope look forward to rewards at the end of the season in the spring.

RAL have two teams in the Oxford and District League both in the 2nd Division. The RAL 'A' team of Peter Kent, Eric Gill, Ian Mead and Arthur Chilvers are currently top of the table with maximum points from their games and must be considered favourites for the title, barring accidents. The RAL 'B' team are much lower in the table but have unfortunately had to suffer the loss of several players. They are just clear of the relegation spots and we hope will remain so.

In the Didcot and District League RAL ran seven teams which is our largest number ever. RAL 'A' and 'B' are securely placed 6th and 5th respectively in Division 1, the best positions we have attained in this division. Arthur Chilvers of RAL 'A' also won the individual division 1 championship. The RAL 'C' team (Tim Pett, Harry Jarvis and Peter Tipper) are currently in second place in division 2 and we hope will maintain this form till the end of the season to gain promotion. Three RAL teams populate division 3 and all are doing reasonably well. RAL 'D', Bob Hopgood, Brian Wyborn and Alex Selsby, are on top of the division having dropped one point so far. Alex has had to leave and two new players Alan Gibbard and Dick Carter have been recruited in his place. Hopefully this team will also remain top of the table. RAL 'E' and RAL 'F' are safely placed in mid-table positions. Worthy of note is the fact that Peter Horton of RAL 'E' was losing finalist in the division 3 individual championship. In the sixth division RAL 'G' are flying the flag and are just outside the promotion spots. They will need to fight hard to move up the table but it is not an impossible task.

In summary, the first half of the season has shown a lot of promise from RAL teams and I hope will be transfered into real trophies at the end of the season. We always need players of varying standards so if you are interested in playing evening league Table Tennis do not hesitate to contact me on Ext 589. Also we run a thriving lunch-time section with two tables in continuous use most lunch-times in R58, so if you are interested and are a Rec Soc member just come along for a game.

B. Wyborn

Bulletin

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Deadline for insertions: Mon 1 Feb