

ABHIJIT DUTTA

I. EDUCATION

Institute	Degree	Date	Division	Subject
IIT, Bombay, India	Ph.D (Met. Engg.)	1989	--	Superplastic behaviour in Titanium alloys
B.E. College Shibpore (Univ. of Calcutta)	B.E. (Met.)	1967	64.8%	Met. Engg.

II. EXPERIENCE

PERIOD : 2006 ONWARDS - TILL DATE

- Teaching Post Graduate and Under graduate Engineering Students of Mechanical and Production branches at MVSRR Engineering College, Hyderabad as a Professor and also guiding Ph.D. Students on research work
- Teaching Post Graduate Students of Materials Engineering at University of Hyderabad as a Guest Faculty.
- As a DISTINGUISHED VISITING PROFESSOR (DVP), delivering special lectures for Faculty and students of 3 reputed Colleges – IIT-KGP, NIT-Trichy and PSG, Coimbatore.

PERIOD : 1979 ONWARDS - TILL 2006

- Working as Scientist 'G' (Director, gr.I) - Leading a group of Scientists and workers in the research fields of Mechanical deformation and metal forming, Simulations etc.
- Nature of work**

Fundamental work in development of superplasticity

Thermomechanical treatments and various other parameters for achieving superplasticity in Ti-6-4, VT-9 (Soviet titanium alloy), Al-Li, Mg-Li, Ti3Al were optimised - The maximum elongation (1725%) was discovered in VT-9 titanium alloy - The mechanism of deformation was established through TEM and SEM studies and by determining activation energies - A Hydrogen charging equipment was built for hydrogenating VT-9 alloy, the superplastic forming temperature was brought down by 150°C - Derived a constitutive equation by co-relating flow stress with volume fraction of phases and validated the same by altering the phase proportions by hydrogen charging - Discovered a phenomenon of stress induced hydrogen diffusion in the tensile region, giving rise to a single phase (beta) microstructure, detrimental to the superplasticity - The exact temperature ranges and concentration ranges for the phenomenon were determined.

Practical forming of sheet metals :

Derived equations for pressure time formulation for blowing hemispheres and box shapes, components leading edge slats for aircrafts - established the set up/equipments for forming the components - Also mathematically modelled and derived equations to predict the thickness variation and to determine the initial blank thickness. Transferred the Technology of Superplastic Forming of Akash Missile's Gas Bottle to MIDHANI for regular production. My mathematical model of forming has been used by *Guy's Hospital, London* for dental implants. South Korean students did their research work based on *my model (Dutta's Mathematical Model)*.

Isothermal forging of advanced materials e.g., Ti₃Al, Fe₃Al, Al-Li alloys :

Stress-strain-strain-rate characteristics were evaluated at various temperatures through hot compression tests - operation windows were determined through dynamic modelling - shape forging was also modelled by fitting the experimental data in a Finite element code - sub scale forgings were performed at the optimum temperature strain rates - The existence of an optimum temperature of forging in Ti₃Al-Nb alloy was interpreted in terms of phase size, volume fraction and partitioning of alloying elements. This work was carried out as a joint collaborative project with INCO, UK(International Nickel Co.).

Lowering the Isothermal forging temperature of TiAl - based alloys by Multi-axial Forging Technique (invented by me)

The conventional- forging temperature (1100 - 1200°C) of Ti - 48 Al- 2 Cr - 2 Nb alloy was brought down to 850°C, by doing multiaxial forging at progressively reduced temperatures.

Isothermal/Superplastic forging + high temperature reaction sintering of Fe₃Al-Nb:

Elemental blending of metal powders were followed by cold isostatic pressing - Reaction sintering and superplastic consolidation were carried out in one operation to reach nearly theoretical density - The billet was isothermally forged to a shape by isothermal forging.

Forming of Armour and Al-Li alloy sheets :

Medium C, low alloy steel Armour plates were treated with different thermomechanical processes to achieve a harness value of nearly 180 VPN, thus improving 'n', 'm', and 'R' values - a limiting draw ratio of nearly 1.8 was obtained.

In another investigation, a fine grained duplex microstructure was produced by repeated rapid heat-treatment cycles. An extended ductility in terms of 220% elongation was achieved at 760 C, 10⁻⁴sec⁻¹. Work is in hand to evaluate the formability in Al-Li alloy.

Warm Forming of Automotive Al - alloys

Worked as a 'Visiting Scientist' in the University of Michigan, on the sponsored project of GM, Ford, Chrysler for development of warm forming parameters and prior heat-treatments for several 5 xxx and 6 xxx series Al alloys.

Development of Super-tough Naval Steel by discovering a NEW CONTROL-ROLLING TECHNIQUE

Developed a “**Controlled Rolling Technique**” which produces a very fine grained structure in Naval Steel, thereby producing a toughness level as high as 200 Joules at -60°C and very large plates are being rolled at steel plants with this technology, and being supplied to Indian Navy. Have been awarded DRDO TECHNOLOGY AWARD in the year 2003, and also AGNI AWARD FOR EXCELLENCE IN SELF RELIANCE (received from Prime Minister) in the year 2006.

Superplastic Punch Forming of Friction Stirred Aluminum Alloy and FE Simulation

(a)Worked as a 'Visiting Scientist' in the University of Missouri, Rolla, during 2003 on the NSF funded project on development of superplastic forming of FSP (Friction Stir Pressed) Aluminum alloy and Finite Element Simulation of the forming process.

(b) Worked as a 'Visiting Scientist in the Missouri University of Science and Technology, during 2007-2008, on the DARPA and Pratt & Whitney funded project on development of Nano-crystalline Aluminum alloys and its deformation behaviour

PERIOD : 1969 TO 1978

- (a) From the year 1974 to 1978 I was working in quality control and inspection of armour plates for Vijayanta Tank at Raurkela Steel Plant.
- (b) From the year 1969 to 1974 I worked in the inspection and quality control of various rolled, forged, drawn, cast, extruded, ferrous and non-ferrous stocks at Ordnance factory, Ishapore.

III. EXPERIMENTAL TECHNIQUES USED

- (a) During the tenure of my above mentioned research work, most of the time I have used mechanical testing machines like INSTRON, DARTEC etc., for both tensile and compression testings in strain-rate controlled, load controlled, stroke controlled or velocity controlled modes.
- (b) For metallographic interpretation I have used optical microscope and SEM exhaustively and TEM occasionally.
- (c) I have worked with hydraulic presses, isothermal forge presses, furnaces etc., for investigation in high temperature deformation work (i.e., superplastic forming and isothermal forming).
- (d) Designed and developed many miniature dies, punches attachments etc., for fitting to the mechanical testing machines and converted it to a miniature isothermal forge press.
- (e) I have manipulated the cold rolling and subsequent spheroidising to bring down the hardness of very hard Armour steel (for improving the formability). A rapid heat treatment in salt bath furnace was also adopted by for heat-treatment of Armour steel and Al-li alloys.
- (f) Designed, developed and used a hydrogen charging apparatus for introducing measured quantities of hydrogen.
- (g) Used Ring Compression techniques for evaluation of Friction factor 'm'.
- (h) Various other techniques (available at my Lab) used by me includes elemental powder blending, cold and hot isostatic pressings, grid etching, electron/X-Ray diffraction etc. However, these machines were operated by the experts in these fields according to my instructions, which have been used by me for processing the material/for interpreting the results.

IV. THEORETICAL AREAS

- (a) For developing the pressure time sequence (for superplastic forming), prediction of thickness variation, I had to carry out exhaustive mathematical analysis, which include plasticity rules, solid geometry, mathematical integrations and numerical solutions etc. I am recognised worldwide as an *expert of Superplastic Forming*.
- (b) I have acquired the knowledge of understanding the effect of phase ratios, volume fractions, phase sizes on stress and strain rate. I have formulated a constitutive equation with these

parameters. This has been validated by altering the volume fraction of phases by hydrogenation of titanium alloys.

- (c) Developed the knowledge of static and dynamic recrystallisation, grain growth, and dynamic recovery, in relation to strain, strain-rate and temperature.
- (d) I learnt to use a *Finite element code* for optimising and designing the die, billet and the isothermal forging process itself.

V. ACADEMIC WORK / GUIDING OF STUDENTS

(A) Osmania University, Hyderabad

- (i) I am recognised by Osmania University, Hyderabad as an “*Official Ph.D. supervisor*” under the Faculty of Engineering, since 1994.
- (ii) I have been chosen as a *member in the Board of Studies in Mechanical Engineering*, since 1999
- (iii) *Examined M.E. (Mech.) thesis* of K.Srinivasa Rao (DRDL/Osmania univ) , February'94.
- (iv) *Examiner, Pre-Ph.D.* presentation of M.M. Hussain , (Osmania univ),March,'94.
- (v) *Guided two students* on B.Tech thesis on thermomechanical working of Armour Steel, Osmania univ, June, '94.
- (vi) *Examined M.E. (Mech.)* dissertation of M. Swamy,Osmania univ, Nov, '94.
- (vii) *Guided 2 students* on B.Tech thesis on Ring Compression Test, Osmania univ, June, 1995.
- (viii) *Guided M.E. (Prod.Engg.)* thesis work of Venkateshwarulu,(Bharat Dynamics Limited,Hyderabad), on Flow Forming, Osmania univ, Feb., '96.
- (ix) *Guided M.E. (Prod.Engg.)* thesis work of V.Vivekanand Rao , Osmania univ, June, '96
- (x) *Guided Ph.D. (Prod. Engg.) thesis work* of K. Mallesham(MVSRCollege.Hyd.) Osmania University, who has obtained his degree in 2001.
- (xi) *Guided B. Tech Project* of K. Vignodar and V. Prasad of Vasavi Engg. College (Osmania University).
- (xii) *Guided Ph.D. (Prod. Engg.) thesis work* of P. Pravakar Reddy (CBIT College.Hyd.), under Osmania University, who has obtained his degree in 2006.
- (xiii) *Question Setter* for Advanced Metal Forming Technology (M. Tech. Prod. Engg., 2nd Semester,2001, JNTU, Hyderabad 500 058.
- (xiv) *Guided M.E. (Prod.Engg.)* thesis work of D. Anil Kumar, Osmania University, June,2000.
- (xv) *Guided M.E. (Prod.Engg.)* thesis work of M. Devender, Osmania University, Feb., 2003.
- (xvi) *Guided B.E. (Mech.Engg.)* thesis work of Saifuddin, Ms. N. Swathi, Vasavi Engg. College, Hyderabad, March 2003.
- (xvii) *Guided B.E. (Mech.Engg.)* thesis work of Ms. Uma, Deccan College of Engineering, and Padmakar, JBIET Engg. College, Hyderabad, April 2003.
- (xviii) *Guided M.E. (AMP)* thesis work Vinand V. Arabale, NIT Warangal, August., 2004.
- (xix) *Guided B.E. (Mech.Engg.)* thesis work of Ms. Sheba Mahalakshmi, M. Lakshmikant and Shyam Sunder Reddy of Vidya Jyothi Institute of Technology, March 2005.
- (xx) *Supervised M.Tech.(Industrial Metallurgy)* dissertation of T. Srinivas, NIT Warangal, July, 2005.
- (xxi) *Supervised* J. Krishnamoorthi, lecturer, PSG College of Technology, Coimbatore, (1.9.05 to 31.12.05) under “*Young Scientist Fellowship*” of Tamilnadu State Council for Science and Technology.
- (xxii) *Guided M.E. (Prod.Engg.)* thesis work of Mohammad Multhan, Osmania University, July,2007, (R.No. 01-05-11607).
- (xxiii) *Guided M.E. (CAD/CAM)* thesis work of Balu Maloth, Osmania University, July,2009, (R.No. 05-08-1703).

(B) Jawaharlal Technological University (JNTU), Hyderabad

- (a) *Examiner for Pre-Ph.D.* presentation on Data Analysis, Oct.'95.
- (b) *Guiding Ph.D. (Prod. Engg.) Work* of Sambasiva Rao, JNTU, since Dec.'95.
- (c) *Guiding Ph.D. (Prod. Engg.) Work* of Ms.A.G. Krishna, since JNTU, May.'95.

(C) Nagpur University

- (a) Member *Curriculum Advisory committee*, 1994.
- (b) *Paper setter & Examiner* of "Processing of alloy steel", M. Tech, summer and winter semesters, 1996.
- (c) *Guided Two Students:* Shirish S. Dhawale and A.K. Varma of NIT, Warangal for their *M.Tech. Thesis*, 2001

(D) NIT Warangal

- (a) *Guided one Students:* Vinand Aravale of NIT, Warangal for his *M.Tech. Thesis*, 2003-2004.

(E) Thapar Institute of Engineering and Technology (Deemed University), Patiala

- (a) *Guided M.E. (Manufacturing Technology. Engg.)* thesis work of KVRK Subrahmanyam, (MVSR Engineering college), submitted to TIET, Patiala, 1996.

(F) Technical Teacher's Training Institute (Min. of Human Resource), Hyd.

Prepared *course materials* for correspondence-cum-contact course on :

- (a) Tensile Testing (March, '94).
- (b) Hardness Testing (March, '94).
- (c) Plastic Deformation of Metals (July, '95).

(G) Ordnance Factories Staff College, Ambajhari, Nagpur

Lectured on *Fundamental Design Aspect of Forging/Rolling/Drawing operations* on 30.7.2001, in the *course on Advances in Metallurgical Technology*.

(H) Engineering Staff College of India, Hyderabad

Guest lecturer for several subjects since year 2004.

(I) IIT, Kharagpur - NIT,Trichy, - B.E.S.University, Kolkata

Distinguished Visiting Professor since year 2006

(I) University of Hyderabad, Gachibowli, Hyderabad (Central University)-

Guest Faculty for PG (Materials Engineering) since year 2008

VI. PUBLICATIONS , PRESENTATIONS and PATENTS

- (a) Published *98 Technical papers* in reputed National and International Journals - most of them as the first author.
- (b) Owner of *Two copyrights and SIX PATENTS* on Superplastic Forming.
- (c) Presented *115 Technical papers* at various conferences, *53 of them on invitation*.

(d) **Reviewer** for Journal papers of International Journals (Elsevier / ScienceDirect) e.g., (1) **Materials Science and Engineering (USA)**, and (2) **Journal of Metal Processing Technology (USA)**.

VII. AWARDS

- (1) Received **DRDO TECHNOLOGY AWARD** in the year 2003, for development of “**Controlled Rolling Technique**” leading to production of extra tough Naval steel plates in the country.
- (2) Received **DRDO TECHNOLOGY AWARD, 2005** in the year 2006, for production of cost effective Warship Grade Steel Plates through “**Continuously cast and Controlled Rolling Technique**” in the country.
- (3) Conferred “**DISTINGUISHED VISITING PROFESSORSHIP**” of AICTE-INAE, for association with IIT, Kharagpur, NIT, Trichy, PSG, Coimbatore, w.e.f. 2006.

PAPERS PUBLISHED

Prof. (Dr.) Abhijit Dutta, ex. Scientist 'G'

1. Superplasticity in Ti-6.5Al-3.3Mo-1.6Zr-0.3Si alloy with different initial microstructures, DMRL Technical Report, DMRL TR 8505, **A.Dutta and N.C.Birla**, Aug.,1985.
2. Superplasticity in aeroengine, titanium alloy VT-9 and its modified compositions, **A.Dutta and N.C.Birla**, Defence Science Journal, Vo.36, no.2, April, 1986, pp. 179 - 190.
3. Stress induced hydrogen diffusion in a $\alpha + \beta$ titanium alloy during superplastic deformation, **Abhijit Dutta and N.C.Birla**, Scripta Met., Aug,1987, pp. 1051-1054 .
4. "Superplastic Forming Technology", in proceedings of Indo-US Workshop on principles of solidification and material processing, held at Hyderabad, Jan 15-21, 1988, **Abhijit Dutta and N.C.Birla**, Oxford IBH Publications, p.915.
5. Structural superplasticity in a Ti-6.5Al-3.3Mo-1.6Zr-0.31Si alloy with different initial microstructures, **A.Dutta, N.C.Birla and K.M.Rao**, Trans. Ind. Inst. of Metals, June, 1987, p.195.
6. Superplastic forming - from fundamental to application, **K.Bose, A.Dutta and N.C.Birla**, DMRL Technical Report, DMRL TR 8624 (1986).
7. Effect of Thermomechanical Processing on Superplasticity in Ti - 6.5 Al - 3.3 Mo - 1.6 Zr Alloy, **A. Dutta** and N.C. Birla, Journal of Materials Science and Technology, April, 1988, p. 341.
8. "Processing of titanium alloy at DMRL", in proceedings of Indo-US Workshop on principles of solidification and material processing, held at Hyderabad, Jan 15-21, (1988), **N.C.Birla, A.Dutta, R.L.Saha and R.B.Subramanyam**, Oxford IBH Publications, pp. 513 - 528.
9. "Superplastic Forming Technology", in proceedings of Indo-US Workshop on principles of solidification and material processing, held at Hyderabad, Jan 15-21, 1988, **Abhijit Dutta** and N. C. Birla, Oxford IBH Publications, pp. 915 - 920.
10. Effect of hydrogen addition in superplastic behaviour of titanium base Ti-6.3Al-2.7Mo-1.6Zr alloy, in proceedings of Sixth International Conference of Titanium, held at Cannes, France 6-9 June 1988, **Abhijit Dutta and N.C.Birla**, p.1183.
11. Closing Report on Development of Near Net Shape Technologies, ie., SPF, SPF/DB, etc., for Titanium and its alloys, 1988.
12. Ph.D thesis on Superplastic forming of Titanium Alloy, 1989.

13. Effect of thermomechanical processing on superplasticity in Ti-Al-Mo-Zr alloy, **A.Dutta**, *N.C.Birla*, Materials Science & Technology, April, 1988, p.341.
14. Some aspects in superplastic behaviour of Ti-6Al-4V, **A.Dutta** and *N.C.Birla*, Trans, Ind, Inst. Met., Vol.36, June, 1983, p.169.
15. Prospects of titanium metal developmental, an overview - Key Note Address at Seminar on Titanium for aerospace, Chemical and other applications - *C.V. Sundaram, R.B.Subramanyam and A.Dutta*, eds., *A.Natarajan and P.P.Sinha*, IIM Trivandrum Chapter, 1985, pp. 1-17.
16. Prospects for titanium in India - Key Note Address at Seminar of Indian Institute of Chemical Engineers held at Trivandrum on 11th Nov. 1986, *R.B.Subramanyam and A.Dutta*.
17. Superplastic behaviour in titanium alloys, Project Closing Report, 1984, **A.Dutta** and *N.C.Birla*.
18. Superplastic behaviour in a Ti3Al-Nb alloy, **A.Dutta** and *Dipankar Banerjee*, Scripta Metallurgia, vol. 24, July, 1990, pp. 1319 - 1322.
19. A New Route of Development of Superplasticity in Al-Li Alloy, **Abhijit Dutta**, A.A. Gokhale and A. K. Gupta, Proceedings of second International Conference on Aluminium, INCAL '91, Bangalore, 31 July, 1991, pp. 577 - 581.
20. New constitutive equation for two phase superplastic titanium alloys, **Abhijit Dutta** and *Amiya K.Mukherjee*, J. of Mat. Sci. and Engg., A 138 (1991), pp. 221-226.
21. Isothermal Forging and Process Modelling of Titanium Aluminides, **Abhijit Dutta**, INCO Engineered Products Limited, Birmingham Technical Report No.23, July, 1989 (Proj.No.1528).
22. Modelling of Isothermal Forging of Aluminium Alloys, **Abhijit Dutta**, INCO Engineered Products Limited, Birmingham Technical Report No.22, July, 1989 (Proj.No.1528).
23. On the flow behaviour of Combustion Synthesised Fe-Al-Nb System, *S.Ranganath, A.Dutta and J.Subrahmanyam*, Scripta Met., Vol.25, 1991, pp. 1593-1596 .
24. Mechanically alloyed-Al-Li alloy with superplastic forming characteristics. *P.W.Sonawane, A.Dutta, W.Krishna Swamy and R.Sundaresan*, International Symposium on Mechanical Alloying, Kyoto, May 7-10, 1991.
25. Design of Model Based Pressure Controller, *T.Satyanarayana, D.R.K.Rao and A.Dutta*, Journal of Instrument Society, India, Vol.21, No.3 , 1991, pp. 116-123.
26. Superplastic Forming, an Analytical Approach, **Abhijit Dutta** and *Amiya K.Mukherjee*, Mat. Sc. & Engg., A.157, Sept., 1992, pp. 9-13.
27. A New Route of Development of Superplasticity in Al-Li alloy, **Abhijit Dutta**, *Amol Gokhale and A.K.Gupta*, in Aluminium Strategies for the Nineties and beyond, Eds. E.S.Dwarakadasa, S. Seshan, K.P.Abraham, Aluminium Association of India, P.O.Box.1260, India, 560012, pp. 577- 581.
28. Modified pressure time sequence and simulation of thickness variation in superplastic forming, **Abhijit Dutta** and *Rakesh Sharma*, DMRL Tech. Report no. TR - 93165, May, 1993, DMRL, Hyderabad, India-500 258.
29. Prediction of phase ratio at the lowest flow stress in superplastic Titanium alloys, **Abhijit Dutta** and *D. Sivakumar*, Material Science and Engineering, A 194 , 1995, pp. L1 - L4.
30. Prediction of initial Blank thickness and thickness profile after superplastic forming, **Abhijit Dutta**, Materials Science forum, Vol.170-172 (1994), pp.757-762.

31. Diffusion bonding - State of art, *P.Mallesham and Abhijit Dutta*, Proceedings of Joining of Materials-7, May 31- 2nd June,1995, European Institute for Joining of Materials, DK- 3000 Helsingør, Denmark.
32. The Influence of Alloying on the mechanical behaviour of the α -phase in Ti-Al-Nb alloys - *T.K.Nandy, A.Dutta, G. Sunderajan and D.Banerjee*; Proceedings of the 8th World Conference on Titanium, 22-26th Oct 1995, Birmingham, U.K. .
33. FE Modelling and Subscale Isothermal Forging of Ti3Al-Nb alloy, *Abhijit Dutta, J.W.Brook, D.Banerjee and P.J.Bridges*, Proceedings of the 8th World Conference on Titanium, 22-26th Oct 1995, Birmingham, U.K. , Titanium '95 Science and Technology, eds. P. A. Blenkinshop, W. J. Evans and H. M. Flower, The Institute of Materials, 1996, pp. 432 - 439.
34. Isothermal Forging of Titanium Alloy - IMI685, *R.Sundaresan, M.C.Somani, A.Dutta and G.G.Saha*, Proceedings of National Conference on forging, Forge India '95, 20-22 April, 1995, Delhi .
35. SHS-Cum-Superplastic forging of Fe3Al-Nb alloy, *Abhijit Dutta*, Proceedings of 3rd International symposium on self propagating high temperature synthesis, Oct 23-27, 1995, Wuhan, China, Journal of Self-propagating high temperature synthesis, vol 4, No.3, 1995, pp. 309-314.
36. Mathematical Modelling of Advanced Forming Techniques, *A.Dutta, A.Venugopal Rao*, Quest 95, Vol.1., DRDL, Hyderabad 58, India, 1995, p. H56.
37. Modelling and simulation in forge preform design, *A.Venugopal Rao, A.Dutta*, *ibid* Vol.2, p.D27.
38. Techniques of analysis of surface texture, *P.Mallesham, A.Dutta and V.S.R. Murthy* *ibid*, vol1, p. H28.
39. Superplastic forming of Ti-6Al-4V alloy, *K.Sombasiva Rao and A.Dutta*, *ibid* vol.1.p.J34
40. Production of submicrocrystalline structure in Ti-48Al-2Cr- 2Nb by multiaxial isothermal forging, *Abhijit Dutta & A.Venugopal Rao* DMRL Technical Report, March'1996
41. Modelling and superplastic forming of various shapes, *Abhijit Dutta*, Proceedings of NSTS '96 (National seminar on Titanium and Superalloys, Hyderabad, India, 28-29, July '96, section III, page 1-8
42. Isothermal Forging of Compressor Disc by FEM , Physical and Sub-scale modelling, *Abhijit Dutta and A.Venugopal Rao*, *Ibid.*, section III, p 48
43. Development of Superplastic grade Ti-6Al-4V alloy rolled plates, K.M.Rao, V.K.Saxena, *A.Dutta, N.C.Birla*, *ibid.*, section III, p 43
44. Effect of surface texture in diffusion bonding techniques and applications, P.Mallesam, *Abhijit Dutta and V.S.R.Murthy*, Proceedings of 11th National Convention of Aerospace Engineers, Institution of Engineers, A.P.Centre, Khairatabad, Hyderabad-500004, India, 7-8, March'96, p 157- 162
45. Simulation of Isothermal forging of compressor disc by combined, numerical and physical modelling techniques, *Abhijit Dutta and A.Venugopal Rao*, J. of Materials processing technology, vol.72, 15 Dec., 1997, pp. 392 - 395.
46. Isothermal forging and TMP for Development of Superplasticity in Al-Li alloy, *Abhijit Dutta, A.A.Gokhale, K.S.Prasad and D.Banerjee*, Proceedings of ICSAM '97, 29-31 January, 1997, IISc, Bangalore, India, Superplasticity in Advanced Materials, Materials Science Forum, vols. 243 - 245, 1997, ed. Atul Choksi, Transtech Publication, Switzerland, pp. 575 - 584.

47. Modelling approach to design of Impression-die forging, *A.Venugopal Rao, Abhijit Dutta, R.Sundaresan*, Mechno-vision-2001, proceedings of X ISME conference, eds, P.B.Sharma, G.S.Sekhon, A.S.Sachdev, S.K.Garg, Newage International (P) Ltd, New Delhi, 1996, pp. II-51 to 56.
48. Warm Forming Behaviour of Automotive Aluminium Alloys, Zhen Guo, *Abhijit Dutta* and Amit Ghosh, Proceedings of TMS Annual Meeting, 15 - 19 Feb., 1998, San Antonio.
49. Mathematical Modelling For Gas Pressure Superplastic Forming of Various Shapes, *Abhijit Dutta*, Non ferrous Materials News Letter, Vol.3, no.4, Aug., 1996, MRSI - TIFAC, Hyderabad, pp.3 - 5.
50. Development of Medium Strength Magnesium Alloy Mill Products : Phase I, A. Gokhale,--*A.Dutta*, --, DMRL Technical Report no. TR 98230, March, 1998.
51. Knowledge Base Systems in Metalworking Operations, A. Venugopal Rao, Abhijit Dutta and V. Balamugan, in CAR & FOF '98, Proceedings of 14 th International Conference on CAD/CAM, Robotics and Factories of the Future,eds. P. Radhakrishnan, R. Srivatsavan, P. V. Mohanram and R. Radharamanan, Narosa Publishing House, London, Dec. '98, pp. 637 – 644.
52. The Role of Surface Finish in Contact Brazing, T. Mohandas, V.S.R. Murthy, , *Abhijit Dutta* and P. Mallesham, Journal of Materials Science Letters, 18 (1999), pp. 167 – 169.
53. Low Temperature Forgeability of Ti-48Al-2Cr-2Nb Alloy, *A. Dutta* and A. Venugopal Rao, Materials Science and Technology, Feb., 2000, vol.16, pp. 231 – 232.
54. Hot Deformation Studies in a Cu-4.5 Wt% Ti Alloy. S. Nagarjuna, *Abhijit Dutta*, T. Singh, Proceedings of International Seminar on Non-Ferrous Metals and Materials, 9-11th Feb, 2000, eds. D.M. Chakravarti, R.K. Jana, V. Kumar, N.G. Goswami, NML, Jamshedpur, 2000, pp. 49 – 53.
55. Structure-property Relationship During High Temperature Deformation of a Cu-4.5 Wt% Ti Alloy, S. Nagarjuna and *Abhijit Dutta*, Materials Science and Technology, March, 2001, vol. 17, pp. 285 – 291.
56. Propensity for Adiabatic Shear Band in W-7 Ni-3 Fe Heavy Alloy System under High Strain Rates, *Abhijit Dutta*, T.P. Bagchi and N. Maitra, P/M Science and Technology Briefs, vol.2, no. 2, 2000. pp. 14 – 18.
57. Superplastic Behaviour of Mg-8Li-6.5Al Alloy, *Abhijit Dutta*, P. Prabhakar Reddi, D. Anil Kumar and M. Komaraiah, Manufacturing Technology, Proceedings of 19th AIMTDR, 2000, eds. V.M. Radhakrishnan, L. Vijayraghavan and N. Ramesh Babu, Dec., 2000, pp. 459 – 463.
58. Preparation and Characterisation of explosively Clad Al-Li Plates, P. Mallesham, Amol A. Gokhale, V.V. Rama Rao, D. G. Deshpande, *Abhijit Dutta*, V.S.R. Murti, DMRL Technical Report no. DMRL-TR-2000279, June, 2000.
59. High Temperature Deformation Behaviour of High Carbon Cast AIM and ESR Fe₃Al Alloys, R. G. Bligidad and *Abhijit Dutta*, Materials Science and Engineering, A301, 2001, p. 162
60. Susceptibility of Shear Localisation in Two Tungsten Heavy Alloy System, , T.P. Bagchi, *Abhijit Dutta* and N. Maitra, P/M Science and Technology Briefs, vol.3, no. 2, 2001. pp. 18 – 21.
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91. Combined Modelling Techniques for Advanced Forgings, **Abhijit Dutta**, Proceedings of All India Seminar on “Recent Advances in Manufacturing Technologies”, RAMT-2005, eds. S.K. Patel and S.K. Sahoo, NIT, Raurkela 769008, India, 22-23rd October, 2005, pp. 1-5.

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96. Continuous Casting and Controlled Rolling of a micro-alloyed HSLA Steel DMR-249A, N. Venkateswara Rao, B.S. Bansal, K. Ankalu, **Abhijit Dutta**, M. Srinivas, K. Muraleedharan, R. Balamuralikrishnan and G. malakondaiah, Metals Materials and Processes (Meshap Science Publishers, Mumbai), vol.19, no. 1-4, 2007, pp. 261-272.
97. Deformation Behaviour of an Ultrafine Grained Al-Ni-Y-Co-Sc Alloy, **A. Dutta**, P.S. De, R. S. Mishra and T.J. Watson, Materials Science & Engineering A, vol.513-514, 15 July, 2009, pp. 239 – 246.
98. Computational Approaches for Advanced Metal Forming Processes, **Abhijit Dutta** in Proceedings of International Conference on Computational Methods in Engineering and Science (IC-CMES '09), eds., P. Ravinder Reddy, M.V.S. Murali Krishna, N.V. Srinivasulu, B.S. Publications, 4-4-309, Giriraj Lane, Sultan Bazar, Hyderabad 500 095, India, Jan, 2009, pp. 27 - 32.

INVITED LECTURES AT UNIVERSITIES AND ORGANISATIONS

1. "Modelling of hot sheet forming", Abhijit Dutta at INCO Engineered Products Limited, Birmingham on 14.4.89.
2. "Superplastic forming of titanium alloys at DMRL", Hyderabad India, Abhijit Dutta at the 6th Meeting of U.K. Superplastic Forming Group, held at University of Manchester on 20.4.89.
3. "Superplastic forming of titanium alloys", Abhijit Dutta at the University of Manchester, on 27.6.89.
4. "Superplastic forming of titanium alloys". Abhijit Dutta at Birmingham University on 2.6.89.
5. "Superplastic Forming" at City University of London on 3.6.89.
6. "Superplastic forming of titanium and other light metal alloys" at University of Leeds on 10.6.89.
7. "Superplastic forming of titanium alloys with special emphasis on aerospace components", at IIM, Koraput, Chapter, HAL, Koraput in February 1986.
8. "Forging of Titanium Alloys" - problems and promises at IIM, Madras Chapter, IIT, Madras on 1.11.82.
9. "Near Net Shape Processing of Titanium Alloys", at Light Structural Materials, VSSC, Trivandrum, 24 Jan, 1991.
10. Superplastic forming/Diffusion bonding, Abhijit Dutta, in special Material processing technique, IIM, Bangalore, on 5.6.93 at HAL, Bangalore.
11. Superplastic forming and diffusion bonding of Industrial alloys, Abhijit Dutta at Confederation of Indian Industries (CII), Bangalore (Hotel Ashok), 11-12th Jan.'94, Bangalore.

12. Superplastic forming of titanium alloys Abhijit Dutta at IIM, B.E.College Chapter, Hotel Taj Bengal, Calcutta, 4th Feb'94.
13. Superplastic forming, Abhijit Dutta at IIM, Defence Chapter, Ishapore, Calcutta, 30th March, 1994.
14. Advanced processing techniques - Abhijit Dutta, Seminar on Engineering materials at MVSR Engineering College, Hyderabad, 29th Oct, 1994.
15. Isothermal forging, Abhijit Dutta, IIM Defence Chapter, Ishapore, Calcutta, May'94.
16. Superplastic forming, A.Dutta, Indian Society for Technical education, MVSR Engineering college, Hyderabad, 25/9/95.
17. "Isothermal Forging : Modelling" , Kavery Engine Project Office, Hyderabad, India on 12/8/99.
18. "Isothermal Forging", Presented as *Chief Guest* of the conference on "Net Shape Manufacturing" at PSG College of Technology, Coimbatore, India, on 3/9/99.
19. "Modelling", presented at AICTE Short Term Course on "Recent Trends in Metal Shaping Techniques" at PSG College of Technology, Coimbatore, India, on 26/11/99.
20. Superplastic Forming , in AICTE / ISTE sponsored Short Term Training Programme on "Design for Manufacturability at REC, Warangal, India, on 5/1/2000.
21. Guest lectures for the Managers of Ordnance Factory on "Fundamental Design Aspects of forging/Rolling/drawing operations" at Ordnance Factories Staff College , Ambajhari, Nagpur, 30/7/01.
22. "Physical, Numerical and Subscale Modelling of Isothermal Forging", as Keynote speaker at IISC, Bangalore, in AFTC organized seminar on "Modelling and Simulation of Materials Processing Operations" , 25-26/8/2001.
23. "Uniform Post-formed Thickness from Mathematically Profiled Blank", as Invited Speaker and Session Chairman at Dept. of Production Engineering, Annamalai University, Annamalainagar-608002, RAMP-2001, 7-8/9/2001.
24. "Design for Deformation and Superplasticity" , as an Expert Lecturer in the National workshop on "Design for Manufacturability and Production Drawing Practice", at JNTU College of Engineering, Kukatpally, Hyderabad, 27/11/2001.
25. "Superplastic Forming / Diffusion Bonding in Defence and Commercial Sectors", invited talk at "National Conference on Processing of Metals", PSG College of Technology, Coimbatore, Jan. 31 to Feb.1, 2002.
26. "Modelling of Isothermal Forging and Superplastic forming of Titanium Alloys", Abhiji Dutta, Symposium on Advances in Metal Forming at IGCAR Kalpakkam, 20 – 21st Jan, 2003.
27. Two lectures "Superplastic Forming" and "Isothermal Forging/Rolling" were delivered on 01- 07-2003 as expert lectures on AICTE-ISTE sponsored short term training programme on "Advanced Metal Working Techniques and Finite Element Simulations in Metal Forming" 30th June – 11th July, 2003, CBIT, Hyderabad.
28. "Near net shape processing" – delivered as invited talk at NIT, Tiruchirapally on 10-02-2004 at METTLE, *inaugurated* the seminar, *judge* for student's presentations and *chairman* for valedictory function.
29. "Deformation and microstructural control in rolling" – delivered at Engineering Staff College of India, Gachibowli, Hyderabad on 26th Aug., 2004, as an invited Guest Speaker for the course on "Advances in Rolling Technologies – Flat Steel Products" (25 – 27th Aug, 2004).

30. “Defects in Hot Rolling and Control” - delivered at Engineering Staff College of India, Gachibowli, Hyderabad on 26th Aug., 2004, as an invited Guest Speaker for the course on “Advances in Rolling Technologies – Flat Steel Products” (25 – 27th Aug, 2004).
31. “Superplastic Forming and Diffusion Bonding” – invited lecture for CEP courses on “Advanced Materials Processing Techniques”, 23rd - 27th Aug., 2004, DMRL, Hyderabad.
32. “Modelling” - invited lecture for CEP courses on “Advanced Materials Processing Techniques”, 23rd - 27th Aug., 2004, DMRL, Hyderabad.
33. “Hot Working” - invited lecture for Naval Inspectors’ Training 26th - 29th Oct., 2004, DMRL, Hyderabad.
34. “Materials Characterisation, Workability and Processing Maps”, guest lecture at Engineering Staff College of India, Gachibowli, Hyderabad during 1st Dec., 2004, for the course on “Advances in Hot Forging Technologies” (1st – 3rd Dec., 2004).
35. “Isothermal Forging”, *ibid* , 3rd Dec, 2004.
36. “Computer Simulation of Hot Forging Processes”, *ibid*, 3rd Dec., 2004.
37. Advanced Forming of Aerospace Materials, invited talk in the National Workshop and Aerospace Conclave, aerocon 2005, BIT, MESHRA, Ranchi, 18th – 20th April, 2005.
38. Finite Element Simulation of Isothermal Forging, invited talk in the course of “Finite Element Simulations in Manufacturing”, CITD, Hyderabad, 500 037, Balanagar, 12th July – 16th July, 2005.
39. Workability and Modelling Techniques in Near Net Forging, **Key note** address in the national forging seminar on “Near Net Shape Forging Technology”, IISC, Bangalore, India, 29th September, 2005.
40. Development of Near Net Shape Titanium Alloy Aero-engine Components by Isothermal Forging, in the national forging seminar on “Near Net Shape Forging Technology”, IISC, Bangalore, India, 30th September, 2005.
41. Combined Modelling Techniques for Advanced Forgings, **Key note address as Chief guest** at All India Seminar on “Recent Advances in Manufacturing Technologies”, RAMT-2005, NIT, Raurkela 769008, India, 22-23rd October, 2005.
42. Advances in Thermo mechanical Heat treatment, **Invited expert lecture**, in the training course on “Recent Developments in heat treatment”, Engineering Staff College of India, Gachi Bowli, Hyderabad, 26th – 30th June, 2006.
43. FEM Simulation of Isothermal Forging, **Invited lecture**, at refreshers course on CAE, organized by MVSR Engineering College, Hyderabad, 3rd – 7th July, 2006.
44. Hot working of Naval Steel, **Invited lecture**, at 3 days training programme for Naval Inspectors, organized at DMRL, Hyderabad, 26th – 28th Aug, 2006.
45. Advances in Metal Forming Techniques, **Guest lecture** at CBIT, Gandipeth, 20th Sept, 2006.
46. Physical and FEM Modelling of Isothermal Forging, **Guest lecture** at Guru Nanak Engineering College, Ibrahimpatnam, Hyderabad, 26th Sept, 2006.
47. “Superplastic forming and it’s innovations”: **Expert lecture under DVP scheme**, delivered at IIT, Kharagpur, 16th, 17th, 18th Nov, 2006.
48. **Invited expert lecture** on “Defects in Rolling and Control” in 3-days course on “Steel Rolling Technologies”, Engineering Staff College of India, Gachi Bowli, Hyderabad, 8th, 9th, 10th Jan, 2007.

49. **Invited expert lecture** on “Rolling Fundamentals, TMCPs and innovative Applications” in 3-days course on “Steel Rolling Technologies”, Engineering Staff College of India, Gachi Bowli, Hyderabad, 8th – 10th Jan, 2007.
50. “Superplastic forming and it’s innovations”: **Expert lecture under DVP scheme**, delivered at PSG, Coimbatore, 18th, 19th, 20th June, 2007.
51. “Superplastic forming”, **Invited lecture**, in the National Seminar on “Latest Trends in Precision Engineering : Focus Aerospace & Energy”, Aeronautic Society of India and Federation of Andhra Pradesh Chamber of Commerce and Industries (FAPCCI), Hitex, Hyderabad, 14 -15 November, 2008.
52. **Invited expert lecture** on “Emerging materials / processes – composites, nano-materials, grain boundary engineering” in 3-days course on “Practical Aspects of Metallurgy for Non-Metallurgists and Technologists”, Engineering Staff College of India, Gachi Bowli, Hyderabad, 17th – 19th Dec, 2008.
53. **Invited lecture** on “Computational Approaches for Advanced Metal Forming Processes” in International Conference on “Computational Methods in Engineering and Science (CMES 09)”, CBIT, Hitex, Gachi Bowli, Hyderabad, 8th – 10th Jan, 2009.
54. **Invited talk** on “Severe Plastic Deformation (SPD) to produce Nano-structure Materials” as Chief Guest Speaker at National Students Symposium “AYAS-09”, JNTU, Hyderabad, 9th March, 2009.
55. “Controlled Rolling of HSLA Steels to attain sub-zero toughness for Indian Naval Applications”: **Expert lecture under DVP scheme**, delivered at IIT, Kharagpur, 27th March, 2009.
56. **Invited talk** on “Advances in Metallurgical Aspects in Manufacturing” at National Workshop on Metallurgical Aspects, Mech. Engg Dept., JNTU, Hyderabad, 30th March, 2009.

OTHER PRESENTATIONS IN SEMINARS

1. Some aspects in superplastic behaviour of Ti-6Al-4V. A.Dutta, N.C.Birla, A.K.Gupta at 35th ATM of IIM, 13-17 Nov.1981.
2. Mathematical and finite element analysis of ring compression test, N.Ramakrishnan, A.Dutta and N.C.Birla, *ibid*.
3. Developments of SPF/DB technique for titanium alloy components, K.Bose, A.Dutta and N.C.Birla, at International Conference on Metal Science at Ranchi, March, 1983.
4. Superplastic forming of titanium alloys, A.Dutta and K.Bose, Semi'nar on titanium for Aerospace, Chemical and other Applications, Trivandrum, 14-16 Dec.1983.
5. Influence of microstructural variations on superplastic behaviour of a creep resistant Ti-6.5Al-3.3Mo-1.6Zr-0.35Si alloy, A.Dutta, N.C.Birla, 37th ATM of IIM, Banaras on 16.11.83.
6. Beneficial effect of hydrogen in superplastic deformation of titanium alloy, Abhijit Dutta, 38th ATM of IIM, Bangalore, 16.11.84.
7. New approach for determining activation energy of superplastic deformation in a titanium alloy, A.Dutta, 39th ATM of IIM at Jamshedpur on 16.11.85.
8. Superplastic forming of titanium alloy (VT-9) hemisphere from analytical pressure-time relationship, A.Dutta, W.Krishnaswamy and N.C.Birla, 40th ATM of IIM at Bombay on 16.11.86.
9. Stress induced hydrogen diffusion during superplastic deformation in a titanium alloy, A.Dutta and N.C.Birla, 41st ATM of IIM at Trivandrum, 12.11.87.

10. Mechanism of superplastic deformation in titanium alloys, A.Dutta, N.C.Birla and A.M.Rao, 42nd ATM of IIM, New Delhi, 14-16 Nov.1988.
11. Superplastic deformation in a single phase Mg-Li alloy, A.Dutta, A.Quadeer, C.R.Chakravarty, Indo-Soviet Powder Metallurgy and Exhibition at New Delhi, Jan. 24-27, 1990.
12. Superplastic forming of titanium alloys, A.Dutta and N.C.Birla, Foundation Meeting of Material Research Society of India, Hyderabad on February, 1989.
13. Development of Ti-Al base alloy as an alternative to Ni-base superalloys in aeronautical applications, Abhijit Dutta, foundation meeting of MRSI at Hyderabad, February, 1989.
14. A new route of development of superplasticity in Al-Li alloy, Abhijit Dutta, Amol Gokhale and A.K.Gupta, in 2nd International Conference on Aluminium INCAL '91 at Bangalore from 31st July to 2nd Aug.1991.
15. Modelling of isothermal forging of axisymmetric objects, Abhijit Dutta, Jeff Brook and P.J.Bridges at 44th Annual Technical Meeting of IIM, at Trichy, 14-17 Nov.1990.
16. Simulation of Isothermal Forging of a Transformed Ti-6Al-4V alloy - Abhijit Dutta and W.Krishnaswamy at 45th Annual Technical Meeting of IIM at Ranchi, 14-17th Nov'91.
17. Superplastic Consolidation of Iron Aluminide, Abhijit Dutta, Insoxex 2, Indo Soviet Powder Metallurgy Seminar and Exhibition, 6-8th Dec.1991 at Hyderabad.
18. Closed Die Superplastic Forging at Fe₃Al-Nb - Abhijit Dutta in 46th Annual Technical Meeting of IIM at Udaipur, 14-17th Nov.1992.
19. Aluminium-Lithium alloy mill form development for Aerospace structural application, A.Gokhale, N.E.Prasad, A.Dutta, C.R.Chakravarty, V.Singh, K.S.Prasad, S.V.Athavale, YVRK.Prasad, 47th annual technical meeting of IIM at Hyderabad, 17-19th Nov '93.
20. Microstructural changes during dynamic recrystallisation in an Al-Li alloy, R.P.Singh, A.K.Singh, A.Dutta and M.C.Pandey, International Conference on Superplasticity in advanced materials, May 24-26 '94, Moscow, Russia.
21. Prediction of initial blank thickness and thickness profile after superplastic forming, Abhijit Dutta, *ibid.*
22. Superplastic consolidation of Fe₃Al-Nb (*poster*), Abhijit Dutta, Material Research Society of India, 5-6th Feb., '94 at DMRL, Hyderabad.
23. Superplastic deformation of light alloys, Abhijit Dutta, 48th ATM of IIM at Visakhapatnam, 14-17th Nov. , 94.
24. Mathematical modelling of advanced forming techniques - Abhijit Dutta and A.Venugopal Rao, Quality Engineering in Aerospace Technologies Conference, Quest'95, Oct 13-14, 1995, DRDL, Hyderabad.
25. Modelling and simulation in forging preform design, A.Venugopal Rao and Abhijit Dutta, *ibid.*,
26. Superplastic forming of Ti-6Al-4V alloy, K.Sambasiva Rao and Abhijit Dutta, *ibid.*
27. Techniques of analysing surface texture for optimising diffusion bonding process characteristics, P.Mallesam, Abhijit Dutta, V.S.R.Murthy, *ibid.*
28. Techniques of analysing surface texture for optimising diffusion bonding process characteristics, P.Mallesham, Abhijit Dutta and VSR Murthy, *ibid*

29. Isothermal Forging of Titanium Alloy IMI-685, R.Sundaresan, M.C.Somani, A.Dutta and G.G.Saha, Proceedings of National Conference on forgings, Forge India'95, New Delhi 21-22 April'95.
30. FE Modelling and subscale isothermal forging of Ti3Al-Nb alloy, Abhijit Dutta, J.Brook, Dipankar Banerjee and Peter Bridges at 8th world conference on titanium, 22-26 October'95, Birmingham, U.K.
31. SHS-cum-Superplastic forging of Fe₃Al-Nb alloy, Abhijit Dutta, 3rd International Symposium on self propagating high temperature synthesis, October 23-27, 1995, Wuhan, China.
32. Simulation of isothermal shape forging of Al-Li alloy, Abhijit Dutta and Amol Gokhale, 14-17 November '95, 49th ATM of IIM at Calcutta.
33. Effect of superplastic forming on the microstructure and properties of commercial Ti-6Al-4V plate, K.Madhusudan Rao, W.Krishnaswamy, P.V.Subrahmanyeshwara Rao, Abhijit Dutta and R.Sundaresan, International Conference on Superplasticity of advanced materials, Bangalore, 29-31, January '97.
34. Isothermal forging and TMT for development of superplasticity in Al-Li alloy, Abhijit Dutta, A.A.Gokhale, K.S.Prasad and D.Banerjee, *ibid*.
35. Effect of surface texture in diffusion bonding techniques and applications, P.Mallesam, **Abhijit Dutta and V.S.R.Murthy**, 11th National Convention of Aerospace Engineers, Institution of Engineers, A.P.Centre, Khairatabad, Hyderabad-500004, India, 7-8, March'96.
36. Modelling and superplastic forming of various shapes, **Abhijit Dutta**, NSTS '96 (National seminar on Titanium and Superalloys, Hyderabad, India, 28-29, July '96.
37. Isothermal Forging of Compressor Disc by FEM , Physical and Sub-scale modelling, **Abhijit Dutta and A.Venugopal Rao**, *Ibid*.
38. Development of Superplastic grade Ti-6Al-4V alloy rolled plates, K.M.Rao, V.K.Saxena, **A.Dutta, N.C.Birla**, *ibid*.
39. Modelling approach to design of Impression-die forging, **A.Venugopal Rao, Abhijit Dutta, R.Sundaresan**, Mechno-vision-2001, proceedings of Xth ISME conference, New Delhi, 1996.
40. Isothermal forging of a complex shape from 4047 Al-alloy, Abhijit Dutta and A.Venugopal Rao, 50th ATM of IIM, Vigyan Bhavan, New Delhi, 14-17, November '96.
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