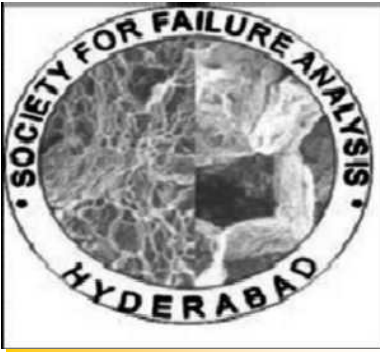




[About SFA](#)

[Objectives](#)

[Local centers](#)

Welcome you all to join as members of SFA! Please find the membership form inside; kindly fill in and contact Secretary of SFA through email.

Experts and experiences:

Message from our President

Dear friends and colleagues,
Seasonal Greetings to all of you. The Society for failure analysis has completed a decade of its existence nurturing the noble cause of integrating and networking the professionals engaged in engineering failure analysis. The growth of the Society needs sincere efforts to reach those people involved in successful designing, processing of materials into components which serve stipulated service and more. This has been seen over the years by unstinted efforts of many of our members which has resulted in growth of SFA to various chapters and currently we can take pride that we have touched a membership of 1000! Continuing further with the success, we shall further strengthen our integration of professionals and improve our technical exchange. With this in mind, I request every one of you to make conscious effort in this direction and help the Society in its growth. I hope that with your support the Society will make strides which would further generate activities for SFA in newer domains.

With Best wishes to all the readers!

Yours sincerely

(P.Jayappal)



From the Desk of Editors

Warm greetings! We are happy to present you the fifteenth issue of the newsletter of Society for Failure Analysis (SFA).

Among the efforts taken to build the society over the last few months, activities by our local centres at various places, organizing workshops for inspiring the young engineering students along with various other professional bodies are some of them. These efforts have really yielded fruits that currently in the last few months, each of the chapters of SFA at Mumbai, Coimbatore and Trichy organized a national event respectively. We provide a glimpse of the programs conducted at these places in this issue as reports.

We have solicited articles from experts in the important area-wear and failure analysis.

We thank the authors for their contributions which are truly significant as far as SFA is concerned.

We take this opportunity to appeal to the Indian industry to use SFA

as a forum to share their experiences on trouble shooting. A great way to add content to this newsletter is to include a calendar of upcoming events. The details of important forthcoming international and national events are included along with; the books recently published on the topics of the subject.

We value your comments, which really boost our enthusiasm to perform better. Therefore, as always, your views and comments, mailed to param@igcar.gov.in are welcome. We wish you all free from failures and a joyful life!

You may visit our web site for your comments/suggestions or any queries : www.sfaindia.org

Kalpakkam

31-08-2016 (P .Parameswaran)

Editor

We encourage you to join the society, Kindly fill up the application form (enclosed at the end of the newsletter) and contact secretary:, post your application with draft to Sri.Jana, Treasurer, SFA, RCMA (Materials), CEMILAC, Kanchanbagh, Hyderabad, 500 058



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About the society**Aims and Objectives of Society for Failure Analysis**

The aims and objectives of the Society shall be:

To serve as National Society to promote, encourage and develop the growth of "Art and Science of Failure Analysis" and to stimulate interest in compilation of a database, for effective identification of root causes of failures and their prevention thereof.

To serve as a common forum for individuals, institutions, organizations and Industries interested in the above.

To disseminate information concerning developments both in India and abroad in the related fields.

To organize lectures, discussions, conferences, seminars, colloquia, courses related to failure analysis and to provide a valuable feed back on failure analysis covering design, materials, maintenance and manufacturing deficiencies / limitations.

To train personnel in investigation on failures of engineering components and their mitigation.

To identify and recommend areas for research and development work in the Country relating to failure analysis.

To establish liaison with Government, individuals, institutions and commercial bodies on failure analysis, methodologies and to advise on request.

To cooperate with other professional bodies having similar objectives.

To affiliate itself to appropriate international organization(s), for the promotion of common objectives and to represent them in India.

To organize regional chapters in different parts of the country as and when the need arises.

To do all such other acts as the Society may think necessary, incidental or conducive to the attainment of the aims and objectives of the Society.

Know your
local
centers





One day programme “METALLURGICAL TESTING AND ANALYSIS” by SFA, Tiruchirappalli chapter On 24th March 2016

A one day programme was organised at Tiruchirappalli by SFA Tiruchirappalli Chapter in co-ordination with National Institute of Technology, Tiruchirappalli, the topic being “**METALLURGICAL TESTING AND ANALYSIS**” on 24th March 2016. The venue was Institutions Building, BHEL Township, Tiruchirappalli 14.

The welcome speech for the inaugural function was given by Dr.S.P.Kumaresh Babu, HOD, MME Department, and NIT. Following this, Dr.R.Vaideeswaran, Chairman, SFA Tiruchirappalli Chapter briefed about the details of the programme and invited Dr.P.Parameswaran, all India council member, SFA and Scientist 'G', IGCAR, Kalpakkam to introduce about SFA to the participants on its origin and activities in various Chapters.

This was followed by the address of the Chief Guest, Sri.R.Easwaran, General Manager, WRI, BHEL, Tiruchirappalli who mentioned the need to know the mechanism of failure in components and highlighted the role of chemistry, microstructure and the condition of the material and their interaction. A vote of thanks was proposed by Prof.Raman Sankaranarayanan of MME Dept., NIT.

The morning session began with an introduction to the world of materials and metals by Dr.K.Santhy, Associate Professor, Care Group of Institutions, Tiruchy, who quickly covered Fe-carbon diagram, Heat Treatment and TTT diagram. Following this, destructive and non-destructive testing were detailed by Dr.S.Muthukumaran, Associate Prof., NIT, Tiruchy. The participants then visited the laboratory at MME dept., NIT to



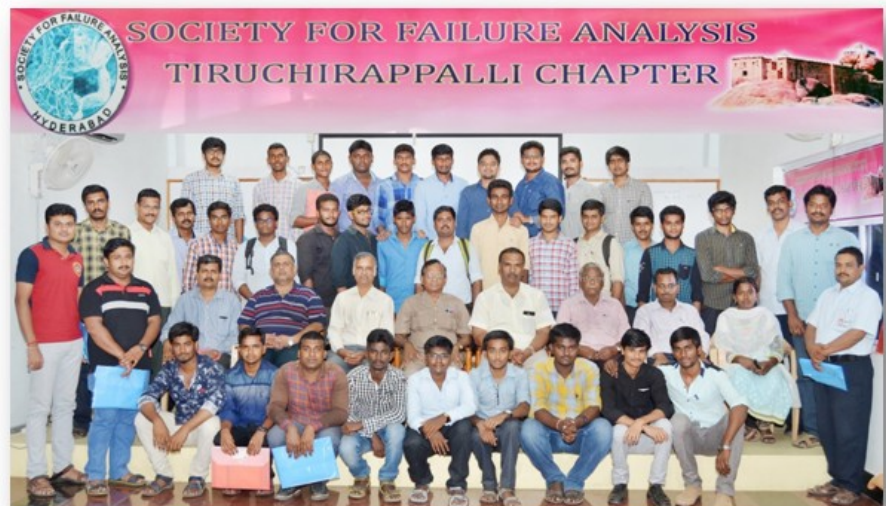


have a practical demonstration of mechanical testing and metallographic examination and had an exposure to the laboratory. After lunch, testing codes, standards and procedures for the various tests carried out in a metallurgical lab including corrosion tests were detailed by Dr.R.Vaideeswaran, Chairman, SFA, Tiruchy Chapter. The last session was handled by Dr.P.Parameswaran, Scientist 'G', IGCAR, Kalpakkam who highlighted microstructural examination and its importance in failure investigations.

The valedictory session was chaired by Dr.P.Parameswaran of IGCAR. Participation certificates were given to the participants after

an interaction with the participants in the feedback session.

The programme was attended by 72 participants drawn from various engineering colleges and industries including a few faculty members of engineering colleges.





RESEARCH COLLOQUIUM ON PROCESSING AND CHARACTERIZATION OF ENGINEERING MATERIALS-

Dr.Mahalingam College of Engineering and Technology, Pollachi
27th February 2016

Departments of Mechanical and Automobile Engg along with the Society for Failure Analysis (SFA), Coimbatore Chapter conducted 'Research Colloquium on Processing and Characterization of Engineering Materials (RCPCEM 16) in Dr.Mahalingam College of Engineering and Technology, Pollachi on 27th February 2016. Nearly 200 participants joined the event. The program began at 9.45a.m. with a Prayer song. Dr.I.Rajendran, HOD, Mechanical Engineering, welcomed the gathering and gave a brief introduction about the Chief Guests' designation and their achievements and about the need on characterization of new engineering materials. Meanwhile the bouquets were presented to the chief guests by Dr.M.Ramakrishnan, Principal, MCET. Dr.P.Parameswaran, IGCAR, Kalpakkam, gave a brief details about 'what SFA is' and the need for conduction of workshops for research purposes.Dr..S.Vijayarangan, Director (Academic), MCET, gave the 'Presidential address' to inject the awareness in students about necessity on their self study topics, they have to learn in various fields of testing and other subjects, that are apart from their curriculum.

The presentation **Materials, Certification and Characterization of**

Airborne Materials was delivered by Shri. D.Pradeesh Kumar, Scientist 'E', Regional Centre for Military Airworthiness, CEMILAC, Bangalore.

The presentation, **Engineering failure analysis- feedback to processing and choice of materials:** was delivered by Dr.P.Parameswaran, Metallurgy & Materials Group, IGCAR, Kalpakkam.

The presentation **Nano- crystalline Nickel alloy coatings and their applications** was given by Dr.J.N.Balaraju, Surface Engineering Division, National Aerospace Laboratories, Bengaluru.

The presentation on **Mechanical properties characterization- conventional and novel methods:**was delivered by Dr.V.Karthik, Metallurgy & Materials group, IGCAR, Kalpakkam.

The presentation " Materials for aerospace application": was delivered by Dr.S.V.S.Narayana Murty, Head, Advanced Metallography section, ISRO, Thiruvananthapuram. The above talks were well received by 122 participants who also became members of SFA- Coimbatore chapter. The certificates were distributed to the participants and the colloquium was concluded with our National anthem.

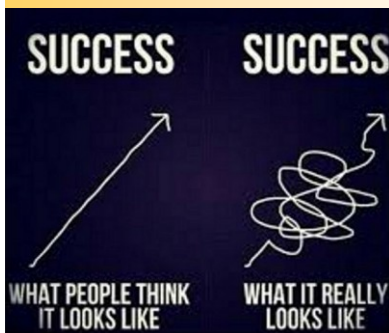
"Failure is success in progress," Albert Einstein once said.





SFA-MUMBAI Chapter organised National Workshop on “Composites: Fracture Toughness, NDE & Failure Analysis”

SFA, Mumbai Chapter conducted a National workshop on Composites-Fracture toughness, NDE & Failure Analysis during 22-23, June, 2016. The workshop was well attended by the academia, industry and research institutes nearby. The event also drew many into the membership of SFA. The efforts of the organizing committee and SFA Mumbai were appreciated by everyone who attended and interacted with the speakers during the event.



SFA Chennai Chapter

Reports organising Technical Lecture in conjunction with general body meeting as a useful exercise.





Information from literature- Compiled by Dr.R.Vaideeswaran, SFA, Trichy

Carrots crack up failure analysts

On the lighter side of Fracture Mechanics

"Did you notice how half eaten food often takes on an appearance similar to that of certain engineering alloys? May be not, unless you happen to be a failure analyst, whose eyes have been trained to look for certain Fractographic and Metallographic characteristics. These features are encountered daily in food ranging from fruit to candy.

For example, a carrot that was subjected to three-point bending overload is shown in Figure .1. The failure analyst states "The crack was perpendicular to the length of the carrot, except at the very last portion to separate. This 'hinge' may have parallels to shear lips in metal specimens."

The cracking observed in bend specimens of carrots is very different from that encountered in crystalline materials, such as metals. The crystalline texture makes it easier for the crack to grow in the direction perpendicular to that in which the crack starts out. As a result, fracture specimens may exhibit curved, "swoop-type" features. *This is often the case for leaf and coil springs.* However, a carrot has transverse planes that make it easy enough for the crack to grow.

In Figure 2, a cross section of a carrot subjected to cantilever bending is shown. Here the radial growth pattern of transverse crack is observed.

A third carrot (Figure 3) was subjected to torsional loading – "twisting in opposite directions by both hands". What resulted were the characteristic oval 45° fracture planes. These planes of high tensile (normal) stress in torsion loading".

- From Journal of Failure Analysis and Prevention ASM - Advanced Materials & Processes , Jan 2004

Compiled by Dr.R.Vaideeswaran, Plant lab, SM (Rtd)
BHEL



Fig. 1 – Carrot fractured in three-point bend test. The crack is perpendicular to the length of the specimen, except at the last portion to separate. This "hinge" may have parallels to shear lips in metal specimens.

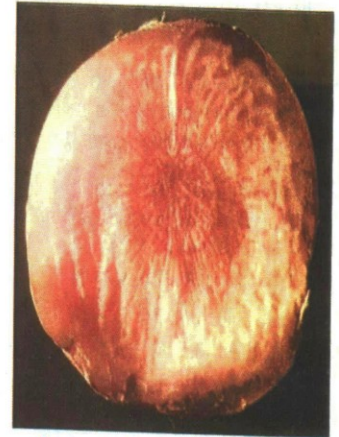


Fig. 2 – Radial growth pattern of a transverse crack in a carrot tested to failure in cantilever bending.

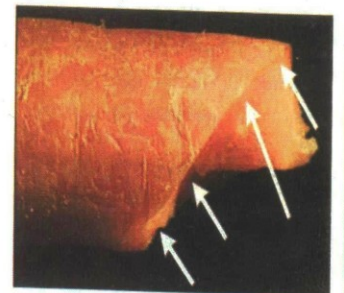


Fig. 3 – Oval 45° fracture planes in a carrot tested in torsion. The 45° crack planes are the planes of high tensile (normal) stress in torsional loading.





Analysis of an aero-engine bolt failure

VN Satish Kumar, Jivan Kumar, Swati Biswas*, SN Narendra Babu

Gas Turbine Research Establishment, Defence Research & Development Organization, Bangalore, India

* Corresponding Author e-mail: swati@gtre.drdo.in

Abstract

A bolt of an aero engine made of GTM Su 718 superalloy got fractured while tightening. The fractured surface was studied under Scanning Electron Microscope (SEM). Gross fractographic features were typical of torsional overload failure. Hardness of the bolt was found to be < 20Rc (Solution treated condition). As per the drawing the bolt should be in solution treated and aged condition. The component not being used with desired heat treated condition was the root cause of the failure.

Keywords: superalloy, solution treatment, aging treatment, torsion

"There is only one way to avoid criticism: do nothing, say nothing, and be nothing."

– Aristotle

1. Introduction

During assembly of an aero engine, a bolt (MJ5x0.8) joining CCOC (Combustion chamber outer casing) with bypass casing was being tightened. The bolt got fractured while tightening. The material of the bolt was GTM-Su-718.

2. Observations

2.1 Visual

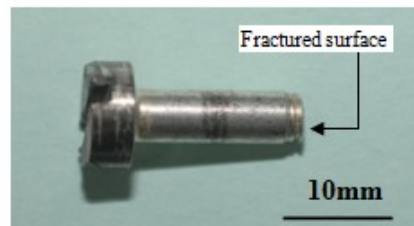


Fig. 1. Photograph of the fractured bolt

The photograph of the fractured bolt is shown in fig. 1. The bolt was found to be fractured from threaded region on shank of the bolt. The fracture was in the plane perpendicular to the bolt longitudinal axis.

2.2. Fractography

The fractured surface was observed under scanning electron microscope (SEM). The fractured surface was found to be flat, shiny and revealed circular rotary deformation marks (Fig. 2) at lower magnification (torsional bands typical of ductile fracture)^[1]. The gross fractographic features were typical of torsional overload failure.

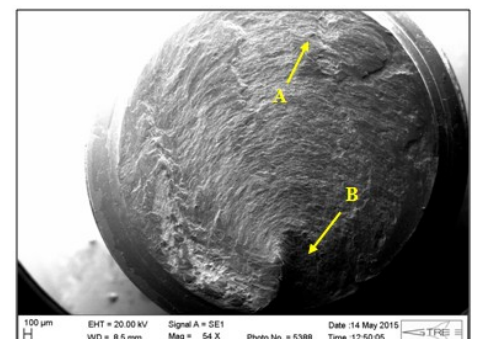


Fig.2. Overview of the fractured surface of the bolt at low magnification showing rotary deformation marks



At higher magnification, elongated dimples with open ends (fig. 3) were observed on major portion of the fracture surface indicating failure under torsional loads. However area near letter 'B' in fig. 2, the fracture features were more towards equiaxed dimples (fig. 4). No metallurgical anomalies were present on the fractured surface of the bolt. The fractured surface was found to be rubbed in few locations.

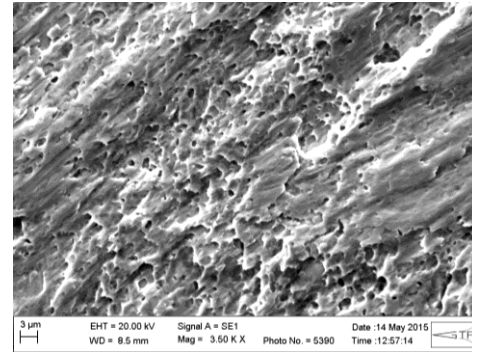


Fig.3. Fractograph showing elongated dimples with open ends (location A in Fig. 2)

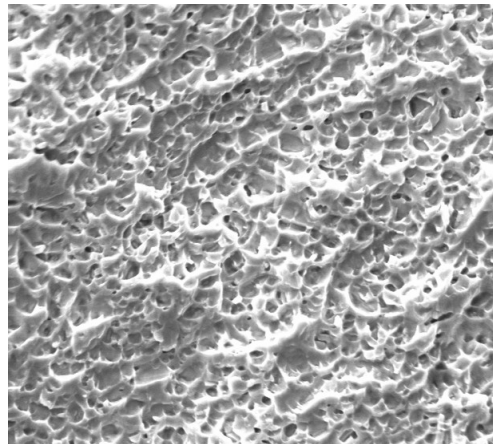


Fig.4. Fractograph showing more towards equiaxed dimples (location B in fig. 2)

2.3 Composition

Semi-quantitative composition analysis of the fractured bolt was carried out using energy dispersive spectrum (EDS) attached to the SEM. The material was found to be super alloy GTM-SU-718.

2.4. Hardness

Hardness of the bolt was checked using Rockwell hardness testing machine. Hardness was found to be <20 Rc which indicates that the bolt is in solution treated condition. The component should have been in solution treated and aged (STA) condition as per the requirement stated in the component drawing.

3. Analysis

The gross fractographic features of fracture indicate torsional overload failure of the bolt. Ductile fractures in torsion take place normal to the axis of the bolt with fracture surface exhibiting rotary deformation marks^[2]. Elongated dimples at the bolt shank periphery indicate that the failure initiated at the bolt shank surface. The region specified by Point B in fig. 2, where features were more towards equiaxed dimples, is the region of final rupture. There were no evidences of any delayed failure. Hardness measured on the part was <20Rc. The expected hardness in STA condition is around 40Rc.

4. Conclusions

1. Fractographic features indicated that the bolt had failed by torsional overload.
2. The material of the bolt found to be GTM-SU-718.
3. The bolt is in solution treated condition with hardness of <20Rc.





5. Recommendations

Bolts should be solution treated and aged prior to assembly.

for their continuous encouragement.

6. Acknowledgement

The authors express their gratitude to the Defence Research and Development Organization for the support to carry out this work. The authors are thankful to Director, GTRE for giving permission to publish these results. The authors are also grateful to Associate Director and Technical Director, Materials Application Group

References

1. ASM metals Handbook, Fractography and Atlas of Fractographs, Volume 9, 8th edition, page no.s 36,43, 305, 410-411.
2. ASM metals Handbook, Failure Analysis and Prevention, Volume 10, 8th edition, page no.s 66 and 101-102, 375.

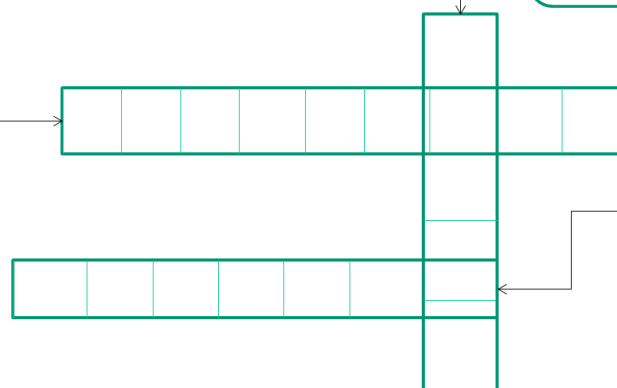
Cross word puzzle

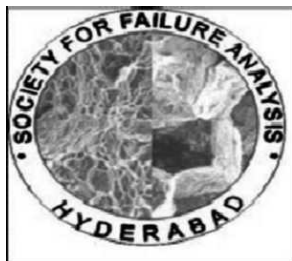


Be used to make fiat car [10]

Crack on bone seen by aged ma[6]

Under plane stress granite fail by [7]





Society for Failure Analysis

Application Form

Society for Failure Analysis

C/O Centre for Military Airworthiness & certification, RCMA (Materials)
Hyderabad 500 058

Phone: 040-24340750; 24348377;

Fax : 040-24341827

E-mail: rdrcma.mat@cemilac.drdo.in

Affix a passport size photograph

Please ✓ applicable

member

☐

Life Member

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Middle

Last

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3. Father's Name/ Husband's Name

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7. Professional Experience:

8. Endorsement by SFA Member

Name	Membership No.	Signature

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10. Name of the Chapter you intend to be attached

(Please refer to Chapters' list)

11. Subscription details:

Payment should be made by cheque / DD favoring "Society for Failure Analysis", payable at Hyderabad. Outstation cheques not accepted.

Amount Rs. Cheque / D.D. No Dated

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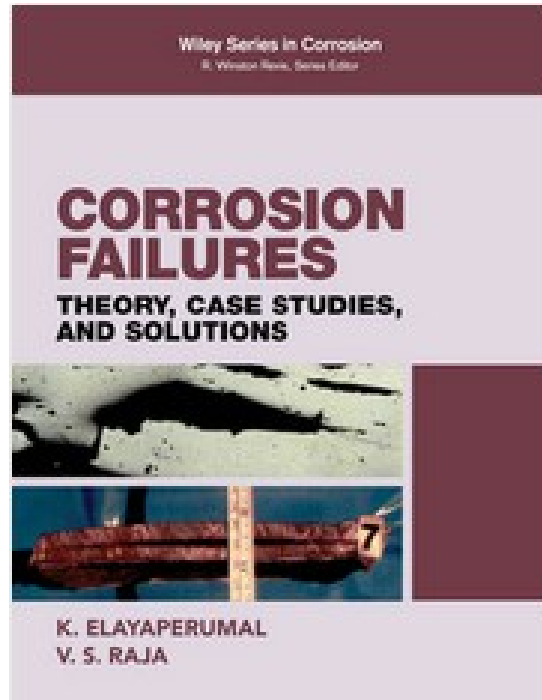
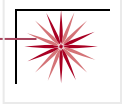
Category	Amount Payable		
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Member	----	Rs.200 (annual)	Rs.200/-
Life Member	----	Rs.1000	Rs.1000/-

12 Declaration by the applicant

If elected, I agree to accept to pay the prescribed yearly subscription, to abide by the rules of the Society and to promote its aims and objects.

Signature of the Applicant

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ANNOUNCEMENT

ASM International Announces New Affiliate Society for Failure Analysis

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ASM International (ASM), the world's largest association of metals-focused materials professionals, has launched a new affiliate society, the Failure Analysis Society (FAS). The society is dedicated to advancing the important role failure analysis plays in the materials science industry.

The new affiliate society emerged from an existing ASM committee that has long offered failure analysis programming and content. FAS will continue to provide collaboration, networking, and educational opportunities for materials science professionals. It will also continue to



have its own technical programming at the annual Materials Science & Technology conference.

Journal of Failure Analysis and Prevention is the official journal of the Failure Analysis Society. ■





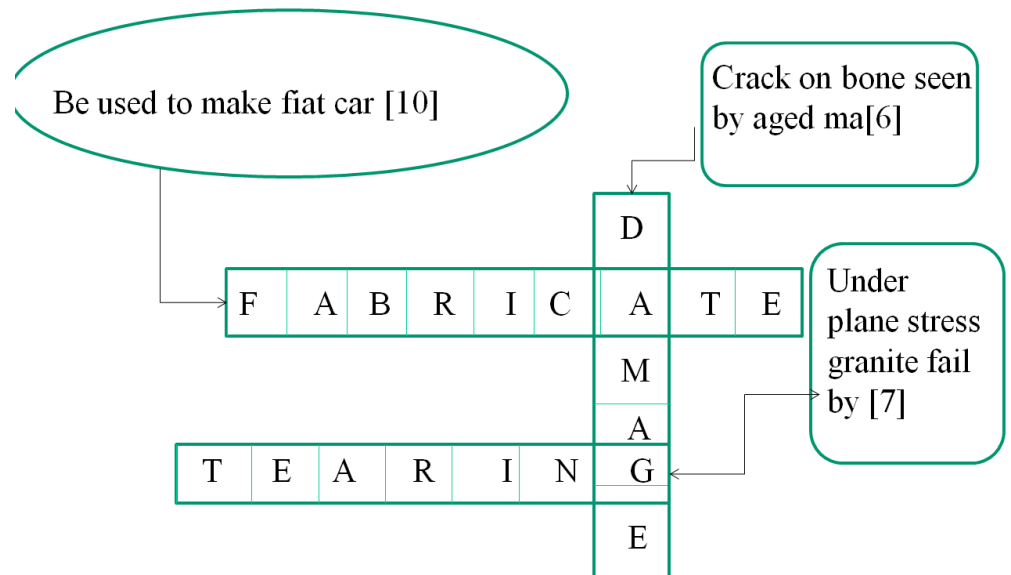
Events in the pipeline



<http://www.iimnmdatm2016.org>

Abstract dead line: 31st August 2016

.Answers to Cross word





Forth coming SFA events* for the current year (2016-17)

- 1) One day event by SFA Chennai at Caterpillar, Chennai – 13th Sept 2016
- 2) One day event on engineering failure analysis- GRT college of engg., Tiruttani- Sept/ Oct 2016

*The exact dates would be added as and when the program gets finalized;

Latest articles in J Failure Analysis and Prevention:

<http://link.springer.com/search?query=engineering+failure+analysis%2C+2015+articles&facet-discipline=%22Materials%22>

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