Sir Dorabji Tata – T R Anantharaman

FACULTY FELLOWSHIP PROGRAMME

Sponsored by
Sir Dorabji Tata Trust, Mumbai and
T R Anantharaman Education and Research Foundation, Hyderabad

Sir Dorabji Tata

Professor T R Anatharaman

Work Reports and Mentor Assessments

2013 – 2015

February 2016

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INTRODUCTION

Sir Dorabji Tata – T R Anantharaman (SDT-TRA) Faculty Fellowship Program

A. Objective of the Program

In today's changing times and the need for quality education, Sir Dorabji Tata Trust (SDTT) and T R Anathraman Education and Research Foundation (TRAERF) have come together to focus on one of the most important aspects of quality education namely, the honing and grooming of teachers in the field of higher technical education, in particular Metallurgical/Materials Engineering education.

Sir Dorabji Tata Trust is one of India's oldest, non-sectarian philanthropic organizations. The Trust is best known for setting up institutions of high repute such as Indian Institute of Science (1909), Tata Institute of Fundamental Research (1945) and many others.

The TRAERF, set up in 2009 in memory of the doyen of metallurgical education and research late Professor T R Anantharaman, works towards promoting quality education in Metallurgy and Materials Science by financially empowering teachers and students of Engineering Institutions to undergo training under expert guidance at renowned Institutions in India and abroad.

These two Institutions have come together in 2013 to set up the Sir Dorabji Tata – T R Anantharaman Faculty Fellowship (SDT-TRA-FF) Program. It is a time-tested fact that a working teacher's methods of teaching as well as the content of his lectures are considerably enhanced if the teacher concerned is associated closely with a distinguished Professor in a renowned University. This association should include attending classes taken by the selected Mentor at least for a period of one full semester.

Accordingly, the SDT-TRA Fellowship awardees would be sent on training for a period of one semester overseas under a Mentor who would be a renowned Professor of international standing. During this period, the Fellow has to attend a regular course of lectures offered by the Mentor Professor to the Metallurgical/ Materials Engineering students of the Mentor's parent institution. In addition he/she would be expected to get exposed to current areas of research under the guidance of the Mentor. The Foundation will decide on a suitable Mentor for each selected Fellow. While the SDT would provide the living expenses of the Fellow for the duration of the training, TRAERF would meet the travelling expenses and Visa charges of the Fellow.

The goal of the two Trusts through this program is to empower the teachers, in the field of higher technical education, with the latest pedagogical tools to provide world class teaching and develop quality education that the nation currently needs. The Fellows are expected to return to their parent Institution on completion of the Program and strive to utilize the knowledge gained for the benefit of the students of that institution as also other similar institutions in the country.

This Program is exclusively meant for teachers of Tier 2 engineering colleges of the country (all Engineering Colleges offering UG and/or PG degree programs in Metallurgical/Materials Engineering, excluding the IITs and IISc who are already provided various kinds of support).

B. Procedure followed for Selection of the Fellows

1. President of the TRAERF writes to the Heads of qualifying Institutions calling for nominations of suitable teachers once every year, specifying the required qualifications, as well as a last date for receipt of nominations by the TRAERF.
2. Nominations of teachers are accompanied by two Undertakings, one by the Head of the Institution to the effect that the teacher will be granted Deputation Leave with full salary for the duration of the Fellowship and the other by the teacher to the effect that, he/she would immediately return to their parent Institution on completion of the Program.
3. Nominations received from different institutions are scrutinized by a Selection Panel comprising nominees of the Sir Dorabji Tata Trust and TRA-ERF
4. Awardees finalized by the Selection Panel are informed of their selection by the President / Secretary of TRAERF.
5. Awardees who have accepted the Fellowship are allotted a Mentor Professor each after obtaining the consent of the Mentor and are asked to finalize their travel plans.
6. On receipt of their travel plans and the required Visa, the awardees are paid their living expenses by the SDTT and their travel expenses and Visa charges by TRAERF by bank transfer.

C. Progress since Inception of the Program till date

Over the last three years a total of six Faculty members of different NITs have been selected as per the procedure listed above and sent to different Mentors in the USA. A list of the Fellows and their Mentors is given in Table 1 of this Report. A Synopsis of their Resumes is given in Table 2.Work Reports by the Fellows and Mentors Assessment of the work done by the Fellows are also presented in this Report along with the full Bio-data of the Fellows. On return from the Fellowship Program all the Fellows have been uniformly appreciative of the excellent opportunity provided to them by the Program to improve their teaching and research skills.

President and members of the Board of Trustees of T R Anantharaman Education and Research Foundation (TRAERF) place on record their sincere gratefulness to the Sir Dorabji Tata Trust (SDTT) for their generous support to the Faculty Fellowship program. This program has helped in a small way to improve the standard of technical teaching by the selected Faculty members.

SDT-TRA Faculty Fellowship Programme 2013-2015

Selected Faculty Fellows – Details

Sl.No.	Name of candidate	Name of Mentor, University & Address	Fellowship duration
1.	Dr. K. Sivaprasad Tel: (Off) 0431-250-3466, (M) +91-94441 92278. Email: ksp@nitt.edu / kspiitm13@gmail.com Assistant Professor NIT, Trichy	Professor Rajiv S. Mishra Dept of Materials Science and Engineering, University of North Texas, POBox 311277, Denton, Texas 76203-1277, USA Tel: (940) 565-3260 Email:rajiv.mishra@unt.edu	Feb – May 2014 (4 months)
2.	Dr. Manoj Kumar Chopkar (M) 08109939981 Email: manoj.chopkar@gmail.com Assistant Professor NIT, Raipur	Professor Srinivasan Chandraseker Center for Materials Processing and Tribology, School of Industrial Engineering , Purdue University, USA Email:chandy@purdue.edu	20.08.2014 to 18.12.2014 (4 months)
3.	Dr. A.R. Ballal (M) 09860382899 Email: ballal.atul@gmail.com Assistant Professor VNIT, Nagpur	Professor Rishi Raj Dept of Mechanical Engineering, University of Colorado at Boulder, Boulder, CO 80309-0427, USA Tel: (303) 492-1029 Email: rishi.raj@colorado.edu	Jan – May 2015 (4 months)
4.	Dr.S.K.Sahoo Tel: 0661-2462566, (M) 09040289501, Email: sursahoo@gmail.com Assistant Professor NIT, Warangal	Professor A.D.Rollett Dept of Materials Science and Engineering, Carnegie Mellon University, 4315 Wean Hall, Pittsburgh, Pennsylvania- 15213-3890, USA Tel: 412-268-3177 Email: rollett@andrew.cmu.edu	19.01.2015 to 15.05.2015 (4 months)
5.	Dr. (Ms.) Amrita Kundu (M) 9007514082 Email: akundu05@gmail.com Assistant Professor Jadavpur University, Kolkata	Professor David Paul Field School of Mechanical & Mat. Engg. Washington State University PO BOX 642920 Pullman, WA 99164-2920, USA Tel: 509 335 8730 Email: dfield@wsu.edu	Aug 8 – Dec 18, 2015 (3 1/2 months)
6.	Dr. V. Sajith Ph:0495-2286525 Email:sajith@nitc.ac.in Associate Professor NIT, Calicut	Professor P.M. Ajayan Benjamn M. and Mary Greenwood Anderson Professor of Engineering Rice University, 6100 Main, MS-321 Houston, Texas 77005-1892, USA Tel: 713-348-5904 Email: ajayan@rice.edu	Aug 22 – Dec 25, 2015 (4 months)

Report on work done at University of North Texas, Denton, USA

Dr. Sivaprasad Katakam

Mentor: Prof. Rajiv S. Mishra

I take this opportunity to sincerely thank **T.R.Anantharaman Education and Research Foundation (TRAERF)** and **Sir Dorabji Tata (SDT) Trust** for selecting me to this Fellowship that provided me a chance to get an exposure to the method of teaching in a higher learning institute in United States of America. The objective of this fellowship offers the budding metallurgists to go further through better teaching. I have availed this opportunity during **February- May 2014.** During this period, I attended the course on "MTSE3050 Mechanical Behavior of Materials" offered by **Prof. Rajiv S. Mishra** of Department of Materials Science and Engineering, University ofNorth Texas, Denton, USA to the undergraduate students~ It was a cherishable and fruitful experience to listen the legendary lectures in the area of mechanical behavior of materials. The excitement and tempo were sustained during the entire course. Prof.Mishra is a wonderful teacher and k~eps the entire class lively with his combination of serious attention and humor along with continuous interaction with the entire class. His constant eye-to-eye contact gathers all the students' attention.

Though, I missed classes of first 10 days as I had to start little late, Prof. Mishra has made me understand the initial portion of his lectures by explaining briefly about the missed classes separately in his chamber and thus helped me to maintain the continuity in understanding the rest of lecture sessions. I always surprise about his spontaneity in providing opt examples, while clarifying the doubts raised by the class.

The course consisted of 12 chapters as suggested by the text book *"Mechanical Behavior of Materials"* authored by *Thomas H Courtney.* The proposed objectives of the course are to make

the students understand the basics of mechanical behavior of materials with special emphasis on metals & alloys and also to make them understand the correlation between microstructure and mechanical properties and its applications in selection of materials for engineering applications. I had the opportunity to observe the way he reviewed the mathematical knowledge such as vectors, scalars and matrices before going to stress states. The sequence and timely briefing on the texture by him is highly appreciable as it helped in explaining the anisotropic behavior of the materials. I am fortunate to contribute in his course material by modifying some of its contents like tensors, yielding criteria, texture and mechanics part, etc. I learnt through the clas:s room instructions of Prof.Mishra, the way of formulating practical problems from day to day life of people along with some common industrial problems, which, I believe, will definitely make my classroom instructions lively and interesting in the coming years in NIT Trichy.

Based on instructions from Chairman, TREARF, I was not allowed to do any research during the academic course. However, in the last one month, I was encouraged to take up a problem to apply

the knowledge of mechanical behavior of materials gained through the full semester course practically in understanding the concepts of mechanical behavior materials. I took up a problem of improving the strength of a ductile high configurational entropy alloy (HEA) having composition Alo 1CoCrFeNi, which exhibits around 250 MPa yield strength with 70% ductility. I performed rolling on the HEA material to 15% and 30% reductions and further to understand the strain path dependency, the material was rolled to 15% straight rolling followed by 15% cross rolling. The results clearly indicated better enhancement of properties in cross rolled condition indicating the clear existence of strain path dependency. The expected enhancement is believed to be due to twin-twin interaction evidenced through work-hardening vs. plastic strain plot. The investigation is in progress and the samples are being analyzed in detail under transmission electron microscope. Interaction with the group members has also helped me in understanding the basics of defect (g. *b)* analysis using TEM.

I am benefited in terms of knowledge gaining and I, therefore, wish many young faculty members of Metallurgical and Materials Engineering like me should get similar opportunities.

As a small step towards fulfilling my wish, I request the chairman, TREARF to accept a small contribution of Rs.25,000/- to the foundation as this kind of contribution may help some more people to get this wonderful benefit.

Mentor's Assessment of work done by Dr. Sivaprasad Katakam

Mentor: Professor Rajiv S. Mishra
University of North Texas, Denton, USA

July 15, 2015

It is my pleasure to write this brief assessment of Dr. Siva Prasad Katakam's four month visit. He was in my group during February – May 2014 under the aegis of T R Anantharaman Sir Dorabji Tata Faculty Fellowship. As per the objective of this fellowship, he attended my course 'MTSE3050 Mechanical Behaviour of Materials', which I taught during spring 2014 semester to undergraduate students of Materials Science and Engineering Department in the College of Engineering, University of North Texas.

He attended the complete course without fail and he was very sincere at this. His interactions on the subject were very in-depth, both during the class and after. His grasp on this subject is pretty good and I believe that he refined it further after attending this course. During the stay he prepared a modified set of course lecture slides to suite the syllabus at NIT Trichy. To apply the knowledge of mechanical behaviour, he took a small project along with one of my doctoral students on the mechanical behaviour of high entropy alloys. He made very significant progress in this short period. It is my firm belief that teaching improves with detailed understanding of the fundamentals associated with that subject.

During this short stay at UNT, he was vibrant in interacting with other members of the group. He shared his experience with the group members by delivering a lecture of ultrafine grained materials. He mentors a few students in day to day research activities during this period with fundamental discussion of mechanical behaviour.

I was impressed with his sincerity, hard work and enthusiasm in learning this subject like a student. I also take this opportunity to thank the fellowship program for selecting Dr. Katakam and sending him to UNT.

Rajiv S. Mishra

Report on work done at at Purdue University, West Lafayette, Indiana, USA

Dr. Manoj Kumar Chopkar

Mentors: Professor M A Dayananda and Professor Kevin P Trumble

I am content to report to the Sir Dorabji Tata Trust and T R Anatharaman Education and Research Foundation that **"Sir Dorabji Tata - T R Anantharaman Faculty Fellowship (SDT-TRA-FF)"** has enabled me to make substantial progress in my academic pursuit. It was an honor to be chosen as a recipient of this prestigious fellowship. I truly value the awarded *SDT-TRA-FF,* which has provided me a wonderful international platform to get exposed in method of teaching in Purdue University, a higher learning academic institute, and among one of the best academic institute in United States of America. The primary objective of **SDT-TRA- FF** to offer young Metallurgists (faculty members) to get exposure in new teaching methodology and provide the platform to interact with renowned professor and researcher in field of Materials and Metallurgical Engineering.

I have availed this opportunity during Fall 2014 (August 20th- December 18th 2014) under mentorship of **Prof. Srinivasan Chandraseker,** Center for Materials Processing and Tribology, School of Industrial Engineering (Courtney Professor of Materials Engineering) Purdue University, USA. However, I did not able to attend his classes during this tenure as his was not offering any course during Fall 2014. Further, Prof. Chandrasekar introduced me to **Prof. M A Dayananda** and **Prof. Kevin P Trumble.** I have attended two the course namely on *"MSE 53100 - Quantitative Analysis of Microstructure" offered by Prof M A Dayananda and "MSE 69700- Fundamentals of Engineering Materials" offered by Prof Kevin P Trumble from School of Materials Engineering, Purdue University, USA.*

The course MSE 53100 - Quantitative Analysis of Microstructure" offered by Prof. M A Dayananda has objective to develop basic background on the stereological concepts for the description of the geometry of microstructures and to employ methods and techniques for quantitative image analysis with selected applications. The course has been designed by taking the consideration of book "Quantitative Stereology", E.E. Underwood, (AddisonWesley, Reading, MA, 1970). I wish to add that, this was my first opportunity to be introduce to such a kind of descriptive course work on Microstructure Analysis. I am glad to say that this course is a mile-stone in my academic carrier. In my view, this is a really very essential and important course for a metallurgist point of view and I am keen to introduce this course work in near future for our graduate and PhD students at NIT Raipur.

Prof. Dayanada has presented a review on basic probability theory and statistical analysis, with particular emphasis on terms and definitions of a microstructure. The tactics, methodology, the way of linking probability and statistical analysis with stereology was commendable. Further, he has emphasized the mathematical foundations, fundamental properties accessible to quantification, the basic stereological relationships, and the microstructural tools needed to quantify the

microstructure. The pace, sequence and continuity in lectures of Prof. Dayananda was very useful and impressive. He made each one of his class to understand every aspect in lecture in very simple manner. It was a wonderful and productive experience to listen lectures of above course by Prof. Dayananda: The enthusiasm and pace were sustained dy.ring the entire course. The assignments were designed and linked with real time industrial problems such as quantification, orientation of microstructure etc, which made classroom instructions lively and brain storming.

Second course, I have audited was an "MSE 69700- Fundamentals of Engineering Materials" offered by Prof. Kevin P Trumble. The course is intended for materials researchers, graduate students from all backgrounds, who seek a deeper understanding of the full spectrum of engineering materials. The course dealt with fundamental relationships between the internal structure, properties and processing in all classes of engineering materials. Comprehensive coverage spanning physical, chemical, thermal, mechanical, electrical, magnetic and optical responses of materials. The teaching methodology for this course was audio-visual. Prof. Trumble was teaching and it was broadcasted so student from other campus (outside of campus) at the same time. I must say that this course is really helpful for my teaching as I am teaching the course Introduction to Materials Science and Engineering. Prof. Trumble retains the entire class lively with his combination of serious attention and humor along with continuous interaction with the entire class.

However, I have not gone through any kind of research work during my stay at Purdue, but I took an opportunity to interact with Dr. Weinong Chen, Professor of School of Aeronautics and Astronaut and School of Materials Engineering. As his research activities mainly involve the development of novel dynamic material characterization techniques and the determination of dynamic responses of engineering materials at high loading rates (high strain deformation). Interaction with Prof. Chen was really fruitful. He has suggested several new ideas, which I am considering to adopt in my research project at NIT Raipur. I have also visited his dynamic material characterization laboratories and saw the different test setup, which are going to help in my research. *(Please note that my research involves in high strain deformation of materials and our small research group is going to build a similar kind of test setup funded by DST under Young scientist grant).* Moreover, through SDT-TRA-Faculty Fellowship, I have had the opportunity to gain diverse experience in teaching methodology and research ambiance that I otherwise would not have had access to. Combined with my academic achievements, I know I will eventually be able to give back to my community because of this experience. For this, I am deeply grateful.

I am also thankful to **Prof. Sudashan Tiwari,** Director NIT Raipur for providing me duty leave to undergo through this fellowship. In closing, I wish to express my sincere gratitude to **Prof. P. Rama Rao,** President, T R Anantharaman Education and Research Foundation and Tata Trust for their generous support. Without such funding, I would never have been able to get such a wonderful experience at Purdue University, USA. I am truly appreciative of this fellowship.

Mentor's Assessment of work done by Dr. Manoj Kumar Chopkar

Mentor: Professor Srinivasan Chandraseker
Purdue University, West Lafayette, Indiana, 4 7906, USA

Lot of water has passed through the Ganges and the Indian Institute of Science has entertained many directors, since we had the pleasure of spending some time together as research assistants at the Metallurgy Department of liSe during 1957-58. I still recall the everr benign, happy smile that you shared with everybody at all times. Your journey of LIFE took you to glorious heights of research accomplishments, professional responsibility and contributions in Science and administration on the Indian stage. Although belated, please accept my heartiest congratulations and felicitations.

It's indeed a good coincidence that Dr. Manoj Chopkar came to Purdue to spend a semester on Sir Dorobji Tata- T.R. Anantharaman Faculty Fellowship. I came to learn from him that you, as President of T.R. Anantharaman Education and Research Foundation, was instrumental in providing this opportunity for him to become familiar with the teaching methods and techniques employed at a large American university like Purdue. It's also gratifying to know that the legacy of Prof. Anantharaman for excellence in teaching that we were familiar with, is being recognized and celebrated through such fellowships as you are administering. Congratulations again.

Our Fall semester classes just ended, and Manoj was sitting in a course I taught this semester.on " Quantitative Analysis of Microstructure", in addition to two other classes taught by other professors. He will surely give you an adequate report on all the courses he attended upon his return to India.

I was very pleased with Manoj's diligence in learning my course material im.olving stereology and image analysis with motivation and purpose, although the material was all new to him. He turned in all the home work and exams voluntarily, even though he was just sitting in my class. He believes that he may. be able to incorporate some of the material he has learnt at Purdue in the courses he would teach at his own institute. I sincerely hope that he would be able to do so, and I wish him well.

I would naturally look forward to an opportunity in the future to be able to say "Hi" to you in person and get reacquainted with your spontaneous, warm smile again. Thank you.

Dayananda

Report on work done at University of Colorado, Boulder, USA

Dr. Atul Ramesh Ballal

Mentors: Professor Rishi Raj

Introduction:

The faculty fellowship for engineering teachers from India is a noble initiate of TR Anantharaman Education Research Foundation (TRA-ERF) and Sir Dorabji Tata Trust (SDTT). Under the banner of this fellowship, the teacher is assigned a mentor of international repute and is supported for attending semester-long courses in the mentor's university.

After getting selected, I joined University of Colorado at Boulder, USA in January 2015. I attended courses in spring semester through May'2015 under the guidance of Prof. Rishi Raj. This document reports the details of academic activities I was involved in during the four months' period.

Academic details:

As the fellowship focuses on the enhancement of the teaching capabilities of the teacher, two courses taught by Professor Rishi Raj were attended.
The two courses were:

1) Mechanical Behaviour of Materials

2) Introduction to Nanoscience

Both the courses were designed for the senior graduate, postgraduate as well as research scholars. Some of the features common to both the courses are outlined below:

- The classes were held twice a week and were of 75 minutes duration each.
- Professor preferred the conventional chalk and the blackboard method of instruction.
- The evaluation pattern, the relevant textbooks, literature, and the course notes were made available by the professor on the course homepage. The information was updated periodically.
- The professor emailed the portions covered in the classes in the particular week.
- Home Work assignments, quizzes were held periodically.
- Group study was highly encouraged by the professor.
- Seminars on the suitable topics were chosen by the students and were presented towards the end of the semester.
- In both the courses, a phenomenon/concept was introduced initially, the underlying science of it was discussed, and a simple model was developed to understand the phenomenon better.

Mechanical Behaviour of Materials:

The course was primarily designed for mechanical engineers. The course focused on corelating the structural / mechanics based parameters with the concepts of materials science and evolving a model out of it.

The topics included:

- Elastic deformation and constants
- Fracture
- Plastic deformation
- Dislocation theory
- Strengthening mechanisms
- High-temperature deformation

A simple method of matching the units in an equation was used to make understand the physical significance of structural/mechanical parameters.

Many research papers involving fundamental work were circulated throughout the semester for better understanding of the topics.

The course helped me a great deal by means of better understanding of concepts as well as developing a different perspective of teaching using model-development approach.

Introduction to Nanoscience:

The course focused on exploring and understanding the wide spectrum of advanced nanomaterials utilising the basics of materials science concepts.
The topics covered were:

- Graphene
- Carbon nanotubes
- Diamond
- Supercomputers
- Coatings
- Batteries
- Optics
- Thermal conductivity

The course was highly inter-disciplinary and excited the minds of people from different backgrounds like physics, chemistry, electronics, mechanical.

Other relevant activities:

- In addition, several relevant seminars presented by various notable speakers on suitable titles like poster presentation etc. were attended.
- The lab group meetings of Professor Rishi Raj were attended. The meetings were held twice or thrice a month.
- The mandatory training on discrimination and harassment policy was completed. The

training was available online.
- The international conference, TMS'2015 was attended.

Benefits:

- The semester-long exposure at University of Colorado, Boulder under the aegis of SDTT-TRAERF Faculty Fellowship has helped me strengthen not only my technical concepts but also the teaching and presentation skills.
- The group meetings helped me to improve the capability to co-ordinate a team of research scholars. The human resource network could be strengthened further to conduct collaborative research in the years to come.

Acknowledgement:

TR Anantharaman Education Research Foundation and Sir Dorabjee Tata Trust are deeply acknowledged for the financial support. Sincere thanks are due to Director, VNIT, Nagpur and Head, Department of Metallurgical & Materials Engineering, VNIT, Nagpur for their encouragement and support. Heartfelt thanks to Prof. Rishi Raj and his team for all the assistance and hospitality at University of Colorado, Boulder.

Mentor's Assessment of work done by Dr. Atul Ramesh Ballal

Mentor: Professor Rishi Raj
University of Colorado, Boulder, USA

2015-06-25

I am writing to give a summary of Dr. Ballal's visit with us from January to May 20 15 to interact with us on the teaching methods in courses related to Materials Science.

Dr. Balla! took great interest in two courses, both at the early graduate level. Our final year undergraduates are also permitted to enrol in them. One course was related to Mechanical Properties of Materials, and the other on Introduction to Nano Science. Dr. Ballal attended all the classes, and often at the end of every class we would have a discussion about the subject matter. He participated actively during the classes as well by asking questions and clarifications.;

I trust that his involvement in these courses was beneficial to him in terms of giving him a broader view of the subject matter and how we approach it in our classes here in the United States. It was certainly a pleasure and instructive to me to have him join me in teaching these two classes.
We have meetings amongst our research group from time to time to discuss topics that we are investigating in the laboratory. Atul did participate in these meetings as well.

In summary, we enjoyed having Dr. Ballal with us for one semester, and hope to stay in touch with him in the future. Certainly he should feel free to contact us if there is any way that I can be of further help to him.

Rishi Raj

Report on work done at Carnegie Mellon University, Pittsburgh, Pennsylvania, USA

Dr. Santosh Kumar Sahoo

Mentors: Professor Anthony D. Rollett

Academic Highlights:

(i) Teaching:

Among different subjects offered by the Department of Materials Science and Engineering at CMU, I have attended two courses, one on Transmission Electron Microscopy taught by Prof. Mark De Graef and the other on Materials for Nuclear Energy Applications taught by Prof. Anthony D. Rollett.

Transmission Electron Microscopy: The lecture started with aberration in lens followed by instrumental details of a transmission electron microscope, diffraction patterns and contrast mechanisms in a transmission electron microscope, and finally high resolution transmission electron microscopy. A brief summary on scanning electron microscope and electron backscattered diffraction was also discussed in the final lectures. I could clear my doubts as well as understand additional information (which I didn't know earlier) from the lectures. The course was coupled with a laboratory course on transmission electron microscopy, but unfortunately I was not allowed to attend the laboratory course because of limitation on the number of students can be allowed inside the laboratory.

Materials for Nuclear Energy Applications: The course covers full range of materials that are relevant to nuclear energy with a focus on materials subject to irradiation (stainless steels, nickel alloys, and zirconium alloys). The lecture started with a brief introduction on nuclear reactors followed by radiation damage event, atom displacement, damage cascade, point defect formation & diffusion, loss of sinks for point defects, radiation induced segregation, radiation induced dislocations, radiation induced voids and bubbles, radiation effects on phase stability, radiation effects on hardening, deformation, fracture toughness, embrittlement, creep and growth, and finally radiation effects on corrosion: emphasis on stress corrosion cracking (SCC).

As the subject was taught by my mentor at CMU, I could interact with him about the grading system, assignment and term paper evaluation – the total accreditation process.

(ii) Research:

From research point of view also my visit was very successful. I could submit one paper on "texture developments in pure magnesium subjected to cold rolling, annealing and hot rolling" to Materials Characterization, an Elsevier journal. The experimental work of the paper was carried out at IISc Bangalore before my visit to CMU. However, the entire analysis has been performed at CMU. In this study pure magnesium was subjected to cold rolling and hot rolling of 90 % reduction in thickness. Cold rolled samples were then subjected to annealing at 200 °C for a

range of soaking times staring from 10 s to 30 min. The texture development in cold rolled, annealed and hot rolled samples was investigated in the present study. A dominant basal texture was observed in the samples. However, the volume fraction of basal orientations (< 0001 > fibre and < 0117 > fibre) decreased with increasing annealing time up to 5 min, beyond which it increased with further increases in annealing time until 30 min. While the volume fraction of orientations away from basal orientation - (<0113> fibre) increased initially at 10 s of annealing time and remain constant on further increasing the annealing time. The hot rolled samples exhibited a stronger basal texture compared to cold rolled and annealed samples.

With the help of graduate students in Prof. Rollett's group I could learn the texture simulation software, VPSC (visco-plastic self-consistent). The simulation package can simulate the texture development during cold deformation of different metals/alloys based on initial texture of the material and amount of strain/strain-path. This helped me to prepare a project proposal on "mechanical properties of titanium and its alloys from their textural aspects" which I have submitted (after coming back to NIT Rourkela i.e. on 20 May 2015) to CSIR, India. The main objectives of the proposal are: correlation of orientation/texture dependent mechanical responses in titanium and its alloys under plastic deformation; correlation of orientation/texture dependent corrosion resistance in titanium and its alloys under corrosive environment; and evaluation of textural and mechanical responses during plastic deformation, using simulation packages such as VPSC and VP-FFT (fast fourier transform based visco-plastic).

Mentor's Assessment of work done by Dr. Santosh Kumar Sahoo

Mentor: Professor Anthony D. Rollett
Carnegie Mellon University, Pittsburgh, Pennsylvania, USA

I am writing to express how glad I am that I was able to host the visit of Professor Santosh Kumar Sahoo from 19 January 2015 to 15 May 2015. We had many excellent discussions about science and he interacted extensively with my research group. He attended two courses during his stay, namely a course on Transmission Electron Microscopy taught by Prof. Marc De Graef and a course taught by myself titled "Materials for Nuclear Energy Applications". More than that, he asked many questions about teaching and learned about how we emphasize teaching excellence at CMU despite being a research university. He also found out about our accreditation process. We have submitted a paper on "Texture development in pure magnesium subjected to cold rolling, annealing and hot rolling" to Materials Characterization. He worked with my graduate students to learn how to use the crystal plasticity code called VPSC (ViscoPlastic Self-Consistent), which permits the user to simulate both texture development and anisotropy response of materials. Based on that experience, which is new for him, he has written a project proposal on "Mechanical properties of titanium and its alloys from their textural aspects", which will be submitted to the Council of Scientific and lndustrial Research (lndia). I look fonrvard to continuing to collaborate with him after he returns to lndia.

Anthony D. Rollett

Report on work done at Washington State University, USA

Dr. (Ms) Amrita Kundu

Mentor: Professor David P Field

3rd February 2016

This report focuses on the activities carried out at the School of Mechanical and Materials Engineering, Washington State University, USA during fall semester 2015 (1st September to 14th December 2015) under Sir Dorabji Tata-T.R. Anantharaman Faculty Fellowship 2015 Programme. During the program, lecture courses on "MSE 316 – Thermodynamics and Kinetics of Materials", offered by Drs. Amy Wo and David Field, and "Modern Topics in EBSD Analysis", offered by Dr. David Field, were attended. A short research project was carried out on "Application of EBSD technique for characterisation of deformed materials" under the guidance and supervision of Prof. David Field. In addition there were regular technical interactions with the graduate research students of Prof. Field's research group on topics such as characterisation of advanced high strength steel, friction stir welding of Aluminium alloy, grain boundary engineering of copper etc. Prof. Field kindly organised technical trips to Pacific Northwest National Laboratory that offered brief exposure to the national laboratory in the USA. The tenure of the faculty fellowship also includes presenting two invited talks as below.

1. Residual stress distribution in electron beam welded P91 steel, Department of Chemical and Materials Engineering, University of Idaho, 3rd December 2015.
2. Deformation behaviour of dual phase steel, School of Mechanical and Materials Engineering, Washington State University, 9th December 2015.

The course covered laws of thermodynamics, solution thermodynamics, free energy composition diagrams, mechanisms and kinetics of diffusion, solidification behavior, interfaces and phase boundaries, phase transformations in solids, oxidation and corrosion. The course is aimed for the senior level undergraduate students with Materials, Mechanical or Physics specialisation. It was a three credits course with three-hour-lecture per week. Homeworks were announced in the class. There were pop quizzes during class period. That allowed the students to bring about the materials the teachers taught and also to bring misconception to the surface where they can be seen and perhaps altered by other students or teachers. There were two midterm examinations during the semester and a comprehensive final examination at the end of the semester. The final grading of students takes account of homework (20%), quizzes (20%), midterm and final examinations (20% each, 60% total).

The classroom had a white board and a display screen where about thirty students used to sit. The professors (Drs. Amy Wo and David Field) offered well structured lectures mainly using

slides. Occasionally the concepts were clarified using board work. The teacher (Prof. David Field) used to present artefacts which were carefully designed to maximise their educational potential within the curricular frame work. The idea is to offer students hands on interaction with real artefacts. The lectures were broken into three four distinct parts with breaks in between. That allowed students who had for one reason or another fallen off, to get back on. The room buzzes, conferring with classmates, calling out questions and jumping up to write or draw on the white boards are all encouraged. The course demonstrated interactive, collaborative and student centered learning. It was a pleasurable active learning experience.

The research project was focused on the evolution of geometrically necessary dislocation (GND) structure following tensile deformation in commercially produced dual phase steel, DP 590. GND measurements were made using electron back scatter diffraction (EBSD). The average GND density increased with imposed macroscopic strain however the rate slowed down with increasing strain. GND density was found to be influenced by ferrite grain size and orientation of the ferrite grains. Small ferrite grains generally had a higher GND density. For this steel the highest GND density was measured for {011}[111] orientations. The ratio of GND to statistically stored dislocation (SSD) density was not constant during plastic deformation of this steel, with the SSD component evolving more rapidly than the GND density. While the GND component of the dislocation density is readily tractable using EBSD measurements, one should generally avoid using this as a surrogate for the total dislocation density.

Report on work done at William Marsh Rice University, Texas, USA

Dr. Sajith Vandana

Mentor: Prof. P M Ajayan, Rice University, Texas

15th January 2016

At the outset, I would like to express my sincere gratitude to T.R.Anantha Raman Education and Research Foundation (TRAERF) and Sir Dorabji Tata (SDT) Trust for selecting me for the prestigious SDT-TRA Faculty Fellowship 2015. I really appreciate the efforts of SDT-TRA in empowering teachers and students of engineering institutions by deputing them to undergo training under expert guidance at renowned institutions abroad.

I have undergone SDT-TRA fellowship programme during August - December 2015 under the mentor ship of Prof. P M Ajayan, Benjamin M and Marry Greenwood Anderson Professor of Engineering, Department of Material Science and Nano Engineering, Rice University, Texas, USA. During this period, I attended the two courses for the undergraduate students. First one was on "MSNE 301 Material Science" offered by Prof. P M Ajayan and second one was " MSNE 201 Introduction to Nano Engineering" offered by Dr. Emilie Ringe. MSNE 301 Material Science course was a 3 credit course which mainly focused on various topics including science of solid materials, metals, ceramics, plastics, and semiconductors, as well as the properties of solid materials from atomic and macroscopic points of view. Most importantly the course provides basic understanding of materials behavior and their correlation with their structure at atomic scale. This course was mainly meant for undergraduate students with materials science and engineering as majors. It was a really a good experience to listen to the lectures by world top class researcher on material science, Prof. Ajayan, emphasizing on the practical aspects of material science in the real world applications.

MSNE 201 Introduction to Nano engineering was a 3 credit course for the undergraduate students. The main contents of the course includes topics on properties of nanomaterials and their applications in engineering, technology, chemistry, energy, biology, and medicine. General discussion of nanotechnology, from multidisciplinary research to consumer products, suitable for all levels and specializations was part of the course and faculty could make the class so much impressive and interesting that most of the students were actively involved in the discussions. Course also included demonstrations, student-lead projects, and lab tours. Invited lectures from the experts from industries and academics were also a part of the course, which made tremendous impact on students as they got exposed to real life situations. As far as grading policy is concerned, for both the courses there were 2 midterm exams (50 minutes) and each exam counts for 25 % of final grade. The final exam which is a comprehensive exam (3 hours) counts for 50 % of the grade. All the exams were closed books/notes. The midterm/final exams covers the topics discussed in class, listed in the reading assignments (listed in the syllabus) and homework assignments. Homework problems and solutions were posted on the course web site for the students to work out.

In addition to auditing the two courses, I was actively involved in the research activities in Prof. Ajayans group. During second week of my visit, I presented my research plan during the group meeting and was approved. I mainly concentrated on two areas of research namely (i) Nano materials for corrosion resistant coating and (ii) Nano encapsulated phase change materials .A corrosion resistant coating with composite layer of exfoliated boron nitride and Molybdenum sulfide, was developed, which is a novel work and a manuscript aiming at a good quality journal is under preparation. As the extension of this work, a coating having both corrosion and wear resistance is being developed at Rice University and NIT Calicut, thus leading to collaboration between these institutes. I believe one of the main advantages of this fellowship programme is this type of collaborative research between world top class institutes abroad and the institutes in India. Second work mainly focused on the "Development of Nano encapsulated phase change material". The phase change material based on paraffin wax was developed for the application as coolants in heat exchangers. With pleasure, I would like to inform that a project proposal, based on this work was submitted to NTPC, during this fellowship period for a funding of 56 lakhs and has been almost approved. I have also attended IMECE ASME Conference 2015 during 13 to 19th November 2015 at Houston, Texas, and presented a paper on "Experimental investigation on the effect of zirconium on the corrosion resistance of ceria nanoparticles".

Prof. P. Rama Rao, President, and Dr.V V Kutumba Rao, Secretary, T R Anantharaman Education and Research Foundation and Tata Trust have extended me full support especially during the time of preparation for this visit, when my visa was kept pending for verification, initially. I wish to express my sincere gratitude to both of them for the whole hearted support, extended to me. I wish to express my gratitude to our Director, Dr.Sivaji Chkraborthy for the encouragement and the support. I extend my heartfull thanks to Prof. P.M.Ajayan for giving me an opportunity to work along with his prestigious group.

Sajith.V

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December 25, 2015

To Whom It May Concern

This is to certify that Dr. Vandana Sajith, Assistant Professor, School of Nano Science and Technology, National Institute of Technology, Calicut, Kerala, India, has been a visiting scholar in my research group in the Department of Materials Science and NanoEngineering, Rice University, Texas, 77005, USA, for the period of four months from August 25, 2015, to December 25, 2015. Dr. Sajith was supported by the Sir Dorabji Tata-T R Anantharaman Faculty Fellowship (SDT-TRA-FF) during his time at Rice University. He has spent the past four months investigating (i) nano materials for corrosion resistance coatings and (ii) nano encapsulated phase change materials. He attended courses instructed by myself (MSNE 301 – Materials Science) and Dr. Emilie Ringe (MSNE 201 – Introduction to NanoEngineering). His participation in my group has been characterized by full academic and all around excellence.

Pulickel M. Ajayan

Benjamin M. and Mary Greenwood Anderson Professor of Engineering
Professor, Department of Materials Science and NanoEngineering
Professor, Chemical and Biomolecular Engineering; Professor, Department of Chemistry