

BIOGRAPHICAL SKETCH

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NAME: Mathew, Mathew

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POSITION TITLE: Associate Professor of Biomedical Science

EDUCATION/TRAINING

INSTITUTION AND LOCATION	DEGREE (if applicable)	Completion Date MM/YYYY	FIELD OF STUDY
Calicut University, Kerala, India	B. Tech.	12/1996	Mechanical Engineering
VTU University, Karnataka, India	M. Tech.	03/2002	Mechanical Engineering, Tribology
Strathclyde University, Glasgow, UK	PhD	11/2005	Mechanical Engineering, Tribology, Tribocorrosion
University of Minho, Portugal	Postdoctoral	03/2008	Tribology, Tribocorrosion

A. Personal Statement

Currently, I am working at Department of Biomedical science, UIC School of Medicine at Rockford, as Associate Professor and leading the lab called, Regenerative Medicine and Disability Research (RMDR). My main research areas are corrosion and tribocorrosion aspects of implant bio-materials in dentistry and orthopaedics. As the behavior of a metal implant in a body environment is a complex issue, the objective of this research is to find an optimum solution related to longevity, biocompatibility and stability by adopting an interdisciplinary approach. By using the concept of synergism between wear and corrosion, I would like to understand not only the degradation mechanisms but also provide solutions to prevent the failure. Such findings can be useful in producing implants with customized surfaces, with superior wear and corrosion resistance, without affecting the required biocompatibility. During last seven years, as the application of tribocorrosion aspects on the dental implants is a vital area, I established a strong research link with the College of Dentistry, University of Illinois in Chicago and working with a capacity of Research Assistant Professor

B. Positions and Honors

1997-1998 Maintenance Engineer, GRASIM Industries, Calicut, India.
2000-2001 Lecturer, Department of Mechanical Engineering, NMAM IT, India
2001-2005 Teaching Assistant, Dept Mechanical Engineering, University of Strathclyde, UK
2003-2005 Tutor (part-time), Top-Up program, Glasgow, UK.
2005-2008 Postdoctoral research Fellow, University of Minho, Portugal
2008-2010 Scientist, Dept. of Orthopedic Surgery, Rush University Medical Center, Chicago.
2010-2012 Instructor, Dept. of Orthopedic Surgery, Rush University Medical Center, Chicago
2010-2012 Adj. Assistant Professor, School of Dentistry, University of Illinois, Chicago.
2011-2015 Adj. Assistant Professor, Department of Bioengineering, University of Illinois, Chicago.
2012-2015 Asst. Professor, Dept. of Orthopedic Surgery, Rush University Medical Center, Chicago
2012-2015 Research Assistant Professor (Part-time-20%), School of Dentistry, UIC, Chicago.
2013- present Director- Tribocorrosion division- Institute of Biomaterials, Tribocorrosion and Nano-medicine (IBTN), UIC, Chicago
2015- present Faculty at Rush Graduate college, Chicago
2016 Associate Professor, Department of Biomedical Science, UIC School of Medicine at Rockford

2016 Associate Research Professor, School of Dentistry, UIC, Chicago.
2016 Associate Professor, Department of Bioengineering, University of Illinois, Chicago

Other Experience and Professional Memberships

2001-now Member, Institute of Physics, London
2001-now Life Member, Tribology Society of India.
2001-now Member, Tribocorrosion net work, UK
2005-2009 Portuguese Materials Society (SPM), Portugal
2005-now Reviewer of Journals: Surface and Coating Technology, Tribology International, Wear
2008-now Editorial board member- Recent Patents in Corrosion and Applied physical chemistry and materials
2009-2013 Chair of session: Coatings for Bio-corrosion, Tribo-corrosion, and Bio-tribology at annual ICMCTF conference.
2013-now Chair of Symposium D: Biomedical and healthcare coatings at annual ICMCTF conference
2013 Co-organizer of Symposium at TMS-2014 conference on (Advanced Materials in Dentistry and Orthopedics)
2014 Co-chair of the conference: Tribocorrosion 2014 (held in Glasgow, April 2014)
2014 Editor-in-chief: "Journal on Bio and Tribo-corrosion" by Springer
2014 Organized a workshop on Tribocorrosion at Orthopaedic Research Symposium (ORS) 2014
2014 Guest Editor: Special cluster issue on tribocorrosion of dental materials, J. Phys. D: Appl. Phy
2015 Chair of 1st, 3rd and 4th IBTN Research day at UIC School of Dentistry

Honors

1999 Best presentation awards, ISTE, India
2000 Best Master Thesis- 2000, ISTE, India
2000 Second Rank, in Master course, VTU, India
2002 Best Presentation award, 1st International conference on Materials and Tribology, Dublin
2002 Best poster award, University Strathclyde, UK.
2003 Short listed for Bodycote: Best Paper award
2005 Postdoctoral fellowship by Foundation of Science and Technology (FCT) Portugal
2009 Peter Blau Best Poster Award: Wear of Materials (WoM 2009).
2010 Finalist for J. Morita Prize Competition of the Geriatric Oral Research Group at International Association for Dental Research in Barcelona Spain (July 2010) (mentor role)
2010 Gold prize winner- coating and thin film conference-health care sector (ICMCTF 2010) (S. Abey: mentor role)
2010 AFP Tyman Research Grant recipient 2010 (V. Barao: mentor role)
2011 Ken Ludema, Best Paper award: Wear of Materials (WoM 2011)
2011 S. Zomorrodian: First place in Best Poster Award for APS table clinic.
2011 Hatton award- International Association Dental Research (IADR), Brazilian section- V. Barao: (mentor role)
2011 Silver prize winner- coating and thin film conference-health care sector (ICMCTF 2011- V. Barao: Mentor role)
2012 Best Poster Award – Titanium 2012 Conference (D Royhman: mentor role)
2013 Gustavo Pinto: First place in Best Poster Award for APS table clinic. (Mentor role)
2013 Finalist for IADR Frechette Award Competition (D. Royhman-Seattle, 2013) (Mentor role)
2013 Selected presentation at Annual Rush Research Form-received travel award
2013 The best poster (second place), Wear of Materials (WOM) 2013, Portland, USA
2014 Shortlisted for the ORS-NIRA (New investigator Research Award) award
2015 Isabella Marques (short listed) IADR 2015 PROS. Frechette Award
2016 Craig Sikora: First place in Table clinic-Research Category (AAFP) (mentor role)

C. Contributions to science

I. **Temporomandibular joints (TMJ)** are also affected by tribocorrosion processes. The function of the TMJ is very important for the life of the patients, and a TMJ total joint replacement may be considered after other forms of treatment have failed. We have several research projects in progress in this area. The main

challenge is how to avoid sudden failure of the implants and minimize the side effects. I served as primary investigator or co-investigator in all of these studies.

1. LG Mercuri, **Mathew MT**, Kerwell S, Lundberg H, Sukotjo C. Temporomandibular Joint Replacement Device Research Wear and Corrosion Technology Transfer from Orthopedics, Journal of Bio- and Tribo-corrosion. 2015, 1:3. 10.1007/s40735-014-0003-7
2. **Mathew MT**, Kerwell S, Lundberg HJ, Sukotjo C, Mercuri LG. Tribocorrosion and oral and maxillofacial surgical devices. The British Journal of Oral and Maxillofacial Surgery. 2014, 52(5):396-400. doi: 10.1016/j.bjoms.2014.02.010
3. Royhman D, Yuan JC, Shokuhfar T, Takoudis C, Sukotjo C, **Mathew MT**. An electrochemical investigation of TMJ implant metal alloys in an artificial joint fluid environment: the influence of pH variation. Journal of Cranio-Maxillofacial Surgery. 2014, 42(7):1052-61. doi: 10.1016/j.jcms.2014.01.029

II. In orthopedics, **tribocorrosion research** is clinically very significant, as the **Total Hip Replacements (THR)** are made of metal based alloys (CoCrMo alloy or Ti alloy). THRs have mainly three zones affected by tribocorrosion: 1) articulating area (head-cup interface), 2) modular junction area susceptible to fretting-corrosion and 3) stem-bone contact area also susceptible to fretting-corrosion. In my research I attempted to simulate such interfaces in an *in vitro* simulator and study the effect of tribocorrosion on the total degradation process of the THR. We identified the synergistic component of wear and corrosion as contributing 40-50% of the total weight loss (metal ion/debris) release from the implant articulations. We also identified the electrochemical mechanism behind the tribolayer formation. The tribolayer also improves the tribological and corrosion properties of the surface. I served as primary investigator or co-investigator in all of these studies.

1. **Mathew MT**, Patel M, Royhman D, Runa M, Jacobs JJ, Wimmer MA, Hallab NJ. Fretting-corrosion at modular junctions, Selected Technical Papers. ASTM- STP1591 on Symposium on Modularity and Tapers in Total Joint Replacement Devices. 2015; Manuscript ID STP-2014-0143.
2. Royhman D, Patel M, Runa MJ, Jacobs JJ, Hallab NJ, Wimmer MA, **Mathew MT**. Fretting-corrosion in hip implant modular junctions: new experimental set-up and initial outcome. Tribology International. 2015 Nov 1;91:235-245.
3. **Mathew MT**, Nagelli C, Pourzal R, Laurent MP, Fischer. A, Jacobs JJ, Wimmer MA. Tribolayer formation in metal-on-metal (MoM) hip joint: an electrochemical investigation. Journal of the Mechanical Behavior of Biomedical Materials. 2014, 29:199-212. doi: 10.1016/j.jmbbm.2013.08.018 PMID: PMC3882021.
4. **Mathew MT**. Jacobs JJ, Wimmer MA. Wear-corrosion synergism in a CoCrMo hip bearing alloy is influenced by proteins. Clinical Orthopedics and Related Research. 2012, 470(11):3109-17. doi: 10.1007/s11999-012-2563-5 PMID: PMC3462838

III. My recent work on **dental implant materials** addresses new degradation mechanisms that can lead to implant failure *in vivo*. One of the major failure mechanisms is tribocorrosion, which is a combined effect of wear and corrosion. I developed a new tribocorrosion set-up and protocol to study dental implant materials, in an oral environment. By understanding *in vivo* mechanisms of damage and failure of dental implants we expect to contribute to the development of innovative approaches to mitigate surface damage and implant loss. I served as primary investigator or co-investigator in all of these studies.

1. Beline T, Marques ISV, Matos AO, Ogawa ES, Ricomini-Filho AP, Rangel EC, Cristino da Cruz NC, Sukotjo C, **Mathew MT**, Landers R, Consani RLX, Mesquita MF, Barão VAR. Production of a biofunctional titanium surface using plasma electrolytic oxidation and glow-discharge plasma for biomedical applications, Biointerphases 2016;11, 011013
2. Marques, ISV; Alfaro, MF; Cruz, NC; Mesquita, MF; Sukotjo, C; **Mathew MT**. Barão, VAR, Tribocorrosion behavior of biofunctional titanium oxide films produced by micro-arc oxidation: Synergism and mechanisms, Journal of the Mechanical Behavior of Biomedical Materials. 2016; 60:8-21
3. **Mathew MT**, Abbey S, Hallab NJ, Hall DJ, Sukotjo C, Wimmer MA. Influence of pH on the tribocorrosion behavior of CpTi in the oral environment: synergistic interactions of wear and corrosion. Journal of Biomedical Materials Research Part B Applied Biomaterials. 2012, 100(6):1662-71. doi: 10.1002/jbm.b.32735

4. **Mathew MT**, Barao V, Yuan JC, Assunção. WG, Cortino S, Wimmer MA. What is the role of lipopolysaccharide on the tribocorrosive behavior of titanium? Journal of the Mechanical Behavior of Biomedical Materials. 2012, 8:71-85. doi: 10.1016/j.jmbbm.2011.11.004

IV. Implant surface modification and diagnostic techniques: In orthopedics and dentistry, it is very important to develop novel methodology to minimize tribocorrosion. Furthermore, new techniques to predict the early tribocorrosion processes in total hip replacements will be very beneficial to clinical management. My recent focus is to develop **biosensor technology** (SMART sensor) and **acoustic emission** techniques to check biosensor suitability for predicting tribocorrosion processes in implants. **Surface modifications** such as nanotubes and different coating techniques are also under investigation and findings are very promising.

1. Hamlekhan A, Sinha-Ray S, Takoudis C, **Mathew MT**, Sukotjo C, Yarin A, Shokuhfar T. Fabrication of drug eluting implants: study of drug release mechanism from titanium dioxide nanotubes. Journal of Physics D: Applied Physics. 2015, 48(27):275401. doi: 10.1088/0022-3727/48/27/275401.
2. Chaudary T, Jacobs M, Wimmer MA, Hallab NJ, Jacobs JJ, Prasad S, **Mathew MT**. Proof of Concept for a Metal-Ion Electrochemical Biosensor (MIEB) for Early Diagnostic Detection of Metal Ion Release in Orthopedic Patients. Transactions of the Orthopaedic Research Society. 14-16 March 2014, New Orleans, Louisiana, USA. <http://www.ors.org/Transactions/60/1777.pdf>
3. Vishwas B, Pai S, Ozvian D, Jacobs JJ, **Mathew MT**, Use of Acoustic emission techniques to monitor the performance of hip implants, AE working group, UIC, Chicago, June 2015.

Complete List of Published Work in MyBibliography:

<http://www.ncbi.nlm.nih.gov/sites/myncbi/1TKTVfIHv76ku/bibliography/44807715/public/?sort=date&direction=ascending>

D. Research Support

Completed Research Support

NIH R03 AR064005 Mathew MT (PI) 12/01/12-11/01/2016 (cost extension period)
Tribocorrosion in Modular Hip Joint Junctions- A Parametric Mechanistic Study: The project is related to identify the many unknowns in the synergistic interactions of wear and corrosion which trigger the early failure/ total failure of the metal based hip joint at modular junctions.

AOMS foundation grant Mathew MT (Co-PI) 12/01/2013-12/01/2016 (cost extension period)
Adopting Tribocorrosion science from Hip implant to TMJ (Temporomandibular Joint)
The proposed project is to understand the tribocorrosion mechanisms in a TMJ joints and comparison with Hip implants

NSF FDN 1160951 Mathew MT (PI) 10/01/12-09/01/2016
Collaborative Research: Tribochemically Induced Gelation and Film Formation at Metal Interfaces
The project is a collaborative effort aimed at understanding the formation of mechanically robust coatings at metal surfaces due to the combined action of both mechanical and electrochemical driving forces.

Ongoing Research Support

NIHR01 AR070181 Mathew MT (co-PI) 09/19/16-10/01/2021
Corrosion Induced Hip Implant Failure: Synergistic Interactions of Patient, Materials, Surgical factors.
The proposed project is to understand the role of microstructure on the corrosion induced hip implant failure.

Patent application

2015 Patent approval: The SMART (Sensing Metal ions Actuated through Resistance Transfer) biosensor (Patent-61/951,354,03/11/2014) to detect metal ion levels in orthopaedic patients