BU STUDENTSHIPS 2015

PROJECT DESCRIPTION

PROJECT DETAILS

Project Title

Development of thermally activated self-lubricated ceramic-based polymeric Nano composite coatings for enhanced performance in conventional lubricants under sliding contact

Project Summary

Sustainable Design Research Centre is led by Dr Zulfiqar Khan (Associate Professor) as Director. SDRC received its REF14 Panel Feedback as, “Sustainable Design Research Group had the highest proportion of outputs judged to be internationally excellent”

Studies of surface wear mechanisms and integration of sustainable development issues within advanced engineering components and systems is the underlying principle of this research centre. Issues of tribology (friction, wear and lubrication), corrosion, thin nano-films and thermal behaviour are studied to help understand their influence on product durability and energy consumption. SDRC has significant industrial funding and partnership in research into structural integrity in terms of corrosion, corrosion condition monitoring and prediction, nano coatings, oil condition monitoring, renewable technology & rolling contact failure. The activities of SDRC include four areas

1. Tribology and Surface Engineering, 2. Renewable Technology & Sustainable Design, 3. Structural Integrity and 4. Design Education

A major international industrial partner is match funding a PhD studentship looking into electroplated composite coatings with incorporated nano particles for tribological systems with a focus on water lubrication. A current research [Dr Khan] to optimise thin nano-films through physical and chemical deposition for optical applications is in progress. This research is part of an exchange programme with Turkey [SDRC webpage].

SDRC has been conducting research in surface engineering to enhance reliability and durability of complex interacting systems. These systems operate in harsh environmental and operational conditions e.g. high temperatures, high humidity, extreme pressures, corrosive environment and starved lubrication. Surface Engineering has been key activity at SDRC to optimise coating solutions to enable components to withstand these operating conditions [1-17].

Ceramic-based polymeric nano composite coatings possess self-lubricated properties with superior tribological performance; this contributes significantly to reduced wear. Although Tribology of the polymeric nano composites is a complex study due to several parameters within interacting systems e.g. particle size, crystallography, mechanical & thermal properties, debris’ morphology, composition & adhesive properties of possible candidate constituent materials, the advancement in polymer composites presents substantial opportunities to enhance service life, durability and reliability of systems.

The proposed research will focus on the synthesis and optimisation of properties for ceramic-based polymeric nano composites followed by advanced characterisation techniques. Tribological properties of the newly developed coatings and enhancement in their performance subject to conventional lubrication conditions in sliding contact will also be investigated.

Aim:

The proposed research will achieve longevity of mechanical interacting systems by enhancing their resilience to failures due to harsh climatic condition and operational conditions.

The objectives of the proposed research are as follows:

1. To investigate and understand the sliding wear mechanisms of ceramic based polymeric Nano coating self-lubricating properties

2. To understand and characterise mechanical, chemical and thermal properties of the candidate Nano particles of above coatings

3. To understand the performance of newly developed coatings in conventional lubricants at high operating temperatures

4. Determine efficiency and fatigue life assessment of coated bearings

Methodology:

1. Development of ceramic based polymeric Nano composites coatings for bearings by state of the art pulse coating technique

2. Material characterisation of novel Nano composite coatings through SEM microscopy, TEM microscopy, FTIR spectroscopy, XRD analysis and TGA studies

3. Tribological studies of the coatings at high temperature by using a micro-friction machine (TE77/57)

4. High Temperature friction testing by CSEH Tribometer.

5. An experimental optimization of bulk properties

6. Investigating the performance of coated ball bearings in conventional lubricants under sliding contact by using pin-on –disc method according to the ASTM G99 standard

7. Fatigue Life Assessment of coated ball bearings by Finite Element Simulation Method (by using ABACUS)

Academic Impact

The proposed research will be conducted in collaboration with National University of Science & Technology, a major International HEI partner.

The proposed research in collaboration with NUST will bring benefits in terms of research, student and staff exchanges, joint publications and guest lectures. This partnership is key to increasing BU international portfolio and presence as international leader in developing nano-coatings.

BU has already two research projects with NUST one of which has started recently and a second to start later this year. The knowledge creation in terms of developing novel nano coatings to enhance systems' efficiency, durability and reliability will benefit a multitude of disciplines from general engineering to materials synthesis and sustainable design. There will be major impacts on classical mechanics, surface engineering and design for durability.

Societal Impact

This research will bring significant benefits to automotive, aerospace, precision manufacturing industries and other mechanical applications by enhancing durability and reliability of structures and systems. It will also bring positive impacts on society through cost and energy savings.

Training Opportunities

BU provides excellent opportunities for personal and professional development through the Graduate School. There are various training opportunities available on campus. BU and SciTech SDRC also holds annual PGR seminars which provide excellent opportunities of showcasing research outcomes, networking and initiating new links.

SDRC is equipped with experimental (Heat Transfer, Fluid Mechanics, Fluid Dynamics, Nano Coating, Corrosion Simulation, Sensor Based Structural Health Monitoring) and analytical (FEA) tools. Surface Analyses Techniques: 2D & 3D, Mechanical Characterisation (High Cycle Fatigue Testing, Hardness Testing, Surface Conditioning, Tensile Testing, Tribo Testing: Micro-Friction & Rolling Contact Fatigue and Cathodic Protection Bench Testing) are available at the SDRC research labs.

Sustainable Design Research Centre has advanced experimental resources which include experimental and analytical tools. The student will receive training on light microscopy, white light interferometer, sample preparation and conditioning and relevant bench testing tools.

SUPERVISORY TEAM	
First Supervisor	Dr Zulfiqar Khan
Additional Supervisors	Professor A Ghafoor (External)
Recent publications by supervisors relevant to this project	List of Publications

INFORMAL ENQUIRIES
To discuss this opportunity further, please contact Dr Zulfiqar Khan via email: zkhan@bournemouth.ac.uk
ELIGBILITY CRITERIA
All candidates must satisfy the University's minimum doctoral entry criteria for studentships of an honours degree at Upper Second Class (2:1) and/or an appropriate Masters degree. An IELTS (Academic) score of 6.5 minimum (or equivalent) is essential for candidates for whom English is not their first language. **Additional Eligibility** Preference will be given to candidates having a Masters or MPhil degree in Mechanical Engineering, Materials or Chemical Engineering/Science. Candidates with previous research experience evidenced by journal publication(s) and for international applicants, a higher level of IELTS above 6.5 will be preferred. This is a three year fully funded PhD studentship the candidates will need to demonstrate their commitment and ability to successfully deliver the research objectives within this time. *Please note that the successful candidate for this studentship will be expected to sign a contract of employment from NUST (National University of Science & Technology, Pakistan) to take an academic role after the successful completion of his/her PhD research degree.*
HOW TO APPLY
Please complete the BU Research Degree Application 2015 and submit it via email to the Postgraduate Research Administrator for Admissions **Suzy Kempinski** - pgradmissions@bournemouth.ac.uk by **Friday 2 October 2015**. Further information on the application process can be found at www.bournemouth.ac.uk/phd-2015