EPSRC-ENG3-THO

Electrodeposited Multilayer Metal Matrix Nano Composite (MMMNC) Coatings for Offshore Protection

Highlights
Development of novel Multilayer Metal Matrix Nano Composite coatings for application to composite wind turbine blade materials.

Development of experimental methods to evaluate the long-term erosion, corrosion and dynamic behaviour of coated composite blade materials.

Establishment of the relationships between manufacturing process parameters, resulting microstructural and surface features, and simulated in-service performance of MMMNC coatings.

Overview
The leading edge of offshore wind turbines is currently protected by soft elastomer tapes, due to their low cost and ease of application during blade manufacture. However, the life span of these tapes is around 10 years and therefore need replacing within the 25 year lifetime of the turbine. There is also significant value lost in-service, as blade erosion can result in up to a 5% power loss each year, according to industry experts. Replacing such tapes, offshore, on assembled turbines is inherently problematic. Industry desires a full-life solution to protecting wind turbine blades from leading edge erosion. Such a solution needs to be erosion resistant, corrosion resistant and damp vibrations resulting from the water hammer effect from impinging spray.

Metal matrix nanocomposite can be produced by electrodeposition of metals from plating baths containing a dispersion of inert nanoparticles. A novel method, pulse reverse plating (PRP), has been developed at Leicester to produce these. To date this method has been successfully applied to produce Metal Matrix Nano Composite (MMNC) coatings. The proposed project will extend this technique to allow the production of Multilayer-MMNC coatings that may be applied to offshore structures such as wind turbine blades.
Long-term (full-life) protection of wind turbines and offshore structures remains a key development priority, due to the current costs involved with maintenance and refurbishment of offshore systems. The proposed project represents an opportunity to develop a proof of concept for a unique coating system and coating process that would resolve these problems and therefore deliver significant economic benefits to industry.

Methodology, Critical Skills and Training and Development

The proposed research will build upon state-of-the-art developments in MMNC coatings at University of Leicester, (led by Dr David Weston), to develop proof of concept Multilayer MMNC coating systems. The research will:

- Develop novel MMMNC coatings designed for resistance to water droplet erosion, corrosion and with vibration damping properties.
- Develop methods to: evaluate the long-term water droplet erosion behaviour of MMMNC coatings on composite substrates, based on ASTM G76-13; evaluate their long-term ice-phobic behaviour; benchmark their vibration response against existing coating systems.
- Correlate electroplating parameters, resulting microstructural and surface features, erosion-corrosion behaviour and vibration response of MMMNC coatings.

The project will result in the development of a unique University facility for erosion, corrosion and dynamic testing to assess the performance of coating systems. The research is likely to significantly reduce the impact of blade leading edge erosion on the performance of offshore wind turbines.

Additional Entry Requirements

- Degree in Chemistry, Materials Science, Engineering, Mechanical Engineering
- Experience of working in a laboratory environment
- Experience/knowledge of engineering design for manufacture
- Experience/knowledge of tribology, corrosion and electrochemical principles

Funding

This research project is one of a number of projects in the College. It is in competition for funding with one or more of these projects. Usually the project which receives the best applicant will be awarded the funding.

Home/EU Applicants

This project is eligible for a fully funded EPSRC studentship which includes:

- A full UK/EU fee waiver for 3.5 years
- An annual tax free stipend of £14,777 (2018/19)
- Research Training Support Grant (RTSG)

Studentships are available to UK/EU applicants who meet the EPSRC Residency Criteria; if you have been ordinarily resident in the UK for three years you will normally be entitled to apply for a full studentship.
If you are an EU student and do not meet the residency criteria, please contact csepgr@le.ac.uk for more information on the funding options available.

International Applicants

- Unfortunately, there is no funding for international students on this project.

Application Instructions

The online application and supporting documents are due by Monday 21st January 2019.

Any applications submitted after the deadline will not be accepted for the studentship scheme.

References should arrive no later than Monday 28th January 2019.

Applicants are advised to apply well in advance of the deadline, so that we can let you know if anything is missing from your application.

Required Materials

1. Online application form
2. Two academic references
3. Transcripts
4. Degree certificate/s (if awarded)
5. Curriculum Vitae
6. EPSRC Studentship Form
7. English language qualification

Applications which are not complete by the deadline will not be considered for the studentship scheme. It is the responsibility of the applicant to ensure the application form and documents are received by the relevant deadlines.

All applications must be submitted online, along with the supporting documents as per the instructions on the website.

Please ensure that all email addresses, for yourself and your referees, are correct on the application form.

For more information, please visit our website at:
https://www2.le.ac.uk/colleges/scieng/research/postgraduate-opportunities/epsrc-2019/instructions