Birla Institute of Technology and Science, Pilani
Hyderabad Campus

Junior Research Fellow (JRF) Position

Date: 17 /11 /2021

Applications are invited for one position of Junior Research Fellow (JRF) in a DST-SERB Start-up Research Grant (SRG) project entitled "**Tribological behavior of Scalable and Low-cost Multilayered MoS_2 Coatings for Hydrogen Valve Applications**", under the supervision of Dr. Prabakaran Saravanan (PI, BITS-Pilani, Hyderabad campus). This project involves development and tribological characterization of multi-layered LBL coatings for hydrogen valve applications.

Deserving JRF may be considered for Ph.D. program at BITS-Pilani if he/she meets the institute norms.

Eligibility:

- ***Essential Qualification:*** M.E./M.Tech/M.Des. in Design /Tribology/Materials Engg/ Materials Science Mechanical Relevant Area.
- Experience in materials chemistry and materials characterization is essential.
- Modelling and analyzing softwares (i.e. MATLAB, FEA) can be an added advantage.
- Candidates with publication(s) will be with priority and GATE will add advantage.

Fellowship: Amount **Rs. 31000** per month

Duration: Two years

Place of work: BITS Pilani, Hyderabad Campus

How to apply:

Interested candidates may apply through this google-form: https://forms.gle/cT5eo146MwQZC1qA7 by **30th November 2021**. (Please show some alignment and justification with the roles/responsibilities/requirements in your cover letter). Please do not send applications via email. Email may only be sent to psaravanan@hyderabad.bits-pilani.ac.in in case of a query.

Preliminary shortlisting will be based on resume and telephonic/audio-visual interview within a week of last date of application. For final interview, the candidate will be informed through e-mail for final interview (virtual mode).

Dr. Prabakaran Saravanan (Principal Investigator)
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Project Summary

The unique properties of hydrogen have led to widespread use in the fields of fuel cell vehicles, space, nuclear and aircraft. Also, combustion and reaction products often contain or produce hydrogen, and machines with sliding parts must be operated in these conditions [1] (Lee, J. A. *NASA/TM-2016-218602*, **2016**). These components suffer under the combined effect of hydrogen embrittlement and friction-induced fretting and fatigue, leading to sudden brittle failure. One such premature failure of components is called "**white etching crack (WEC)**", occurring in hydrogen systems (valves) and wind turbine gearbox etc. [2] (Evans, *Mater. Sci. Technol*. (**2012**) 28, 3-22). Also, using a hydrocarbon lubricant oil is not recommended due to dissociation of oil into hydrogen and carbon. The hydrogen generated from lubricant dissociation, permeates into the steel and causes hydrogen embrittlement. This hydrogen generation and permeation could be avoided to some extent by employing solid lubricant coatings if they have the required durability and strength. Unfortunately, most solid lubricants do not have the required wear durability and strength. **The key scientific question is "Can the wear durability of solid lubricant coatings be improved to protect against both hydrogen embrittlement and friction?"**. Yes, if some novel fabrication technique is adopted (such as layer-by-layer (LbL) coating), the properties of the coatings could be improved significantly.

Therefore, the tribological behaviour (i.e. friction and wear) of ultra-low friction solid lubricant coatings in extreme hydrogen environments such as hydrogen distribution systems, requires detailed investigation for reducing the energy loss from friction, to prevent the hydrogen permeation into steel and to enhance the durability of components, i.e., valves and regulators etc. Here in this proposal, the tribological properties of novel polyethylenimine / molybdenum disulfide (PEI/MoS_2)n multilayered coating (*n* is the number of bilayers) developed using a novel layer-by-layer (LbL) dip-coating technique, will be explored for high pressure hydrogen valve applications. Layer-by-Layer (LbL) is an extremely cost-effective, simple, non-toxic, scalable dip-coating technique, when compared with typical very expensive physical and chemical vapour deposition (PVD&CVD) techniques [3] (*Science* (**1997**) 277, 1232–1237). The developed coating should prevent the hydrogen permeation into steel parts and, also provide the better wear durability for real-time hydrogen valve applications. Also, effect of hydrogen (H_2) on friction and wear mechanisms of $(PEI/MoS_2)_n$ coatings will be investigated thoroughly. The overall objectives are to study the tribology of novel MoS_2 LbL coatings for hydrogen valve application and also study the hydrogen permeation barrier properties of the coating.