**INDIAN INSTITUTE OF TECHNOLOGY PATNA**
**BIHTA PATNA-801106**
**RESEARCH & DEVELOPMENT UNIT**

**ADVERTISEMENT NO: R&D/451/SERB/181** **DATED: 14.01.2021**

Project No. **DOA-451**

Applications are invited in the prescribed format only for a research project funded PhD position in the Department of Mechanical Engineering, IIT Patna.

**1. (a) Name of the temporary assignment** : PhD position funded through project - JRF

**(b) Number of Post** : One (01)

**(c) Duration of the Post** : Two (02) years initially followed by extension subject to satisfactory performance

**2. Name of the temporary research project**: Development of an Ionic Liquid Based Ultra-High Heat Dissipation Module for Energy Efficient Boiling Systems

**3. Name of the sponsoring Agency** : Science and Engineering Research Board (SERB)

**4. Fellowship/Salary** : Rs. 31000/- plus 8% HRA for the first two years followed by Rs. 35000/- plus 8% HRA (subject to satisfactory performance)

**5. Qualifications & Experience**

a) For candidates with M.Tech./ME/MS as qualifying degree, first class (minimum 65% marks or 7.0 CPI) in M.Tech./ME/MS with GATE/NET qualifications and first class (minimum 60% marks or 6.5 CPI) in B.Tech./BE, 12$^{th}$ and 10$^{th}$ class.

b) For candidates with B. Tech./BE as qualifying degree, 75% marks or 8.0 CPI in B.Tech/BE form institutes other than IITs/IISc and 7.0 CPI in B.Tech. from IITS and IISc with valid GATE score and first class (minimum 60% marks or 6.5 CPI) in 12$^{th}$ and 10$^{th}$ class.

c) The age should not exceed 28 years for a candidate with BE/B.Tech/M.Sc. degree as the highest qualification and 32 years for a candidate with ME/M.Tech/MS degree as the highest qualification.

d) Relaxations for SC/ST/OBC/women/PD will be given as per the GoI rules.

**6. Description of the ONLINE MODE of the selection process:**

**Application procedure:**

1. Candidates interested in this position and satisfying the qualification criteria should write an email to the project investigator Dr. Rishi Raj, Department of Mechanical Engineering, IIT Patna (Email IDs: **rraj<at>iitp.ac.in** and **rraj.iitp<at>gmail.com**).
2. The **subject of the email** should read as "*PhD Position DOA-451*". The last date for receiving this email is **5$^{th}$ February 2021**.

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3. The email MUST include the **scanned/pdf copy of duly filled application form** (see attached word document) with applicant's signature.
4. The email MUST include self-attested scanned **pdf copy of all supporting documents** (degree certificates, mark-sheets, GATE scorecard, and category certificate, if applicable).
5. The application should additionally include a **500-word statement of purpose (SOP)**. This document should elaborate on your interest in this project and any relevant prior experience/skills which would help you in solving the assigned research problem.
6. The application should also include a brief **Academic CV** not exceeding two pages.

IIT Patna reserves the right to not shortlist any candidate in case the application email does not contain complete information backed up by supporting documents as listed above.

All candidates who apply via email by **5$^{th}$ February 2021** (deadline) and are shortlisted will be informed regarding the further details by 10$^{th}$ February 2021.

**Date of ONLINE Interview: 12$^{th}$ February 2021** (*13$^{th}$ February has been kept as the reserve day in case of large number of applications*). It is the responsibility of the applicant to ensure that they have a reliable internet connectivity on the date of online interview.

**7. About the Project:** In this project, we propose to develop a high heat dissipation boiling module. Specifically, we propose to demonstrate heat transfer coefficient (HTC) values large than 90 kW/m²-K while ensuring a very high critical heat flux (CHF) value in excess of 1.5 MW/m². As a reference, these numbers imply a 100% enhancement in HTC and around 50% enhancement in CHF in comparison to the standard case of boiling with water typically used in practical applications. We propose to achieve this metrics via the use of ionic liquids (ILs) as additives in water. ILs basically are molten salts typically liquid at room temperature. They have a very low vapor pressure, are non-volatile, non-flammable, and stable at higher temperatures. Due to these properties, they have emerged as a potential replacement of surfactants in various applications such as enhanced oil recovery, separation science, and biomedical applications such as drug delivery, among others.

In particular, ILs containing longer alkyl chain belong to an important category of amphiphiles known as surface-active ionic liquids (SAILs). SAILs exhibit better surface activity compared to conventional surfactants containing the same alkyl chains. We have recently demonstrated the potential of surface-active ionic liquids for improving the energy efficiency of

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boiling based energy and thermal management systems in our lab. The published experimental results demonstrate that ionic liquid additives in water can simultaneously enhance the HTC and the CHF in comparison to surfactants. Our characterization efforts attribute this promising trend to the improvement in surface wettability due to the deposition of ionic liquids on the boiling surface. Please note that this trend is diagonally opposite to what is typically observed with surfactant solutions. While the HTC was also larger in comparison to the baseline case of boiling with pure water, a slight deterioration in CHF was however reported. In this proposed project, we intend to explore many of this new class of additives to explore the area of simultaneous fluid and wettability modification. The eventual aim is to tune this strategy to facilitate simultaneous HTC and CHF enhancement even in comparison to the boiling with pure water. We believe that the outcomes from this project will enable the development of a novel heat dissipation strategy for energy efficient boiling systems. Such steps are crucial to minimize the burden on our energy resources for ensuring a sustainable future.

Applicants may also contact Dr. Rishi Raj and visit www.iitp.ac.in/~rraj for further details on the research undertaken in the Thermal and Fluid Transport Laboratory (TFTL), IITP.

**Deputy Registrar**

Copy to:
1. Associate Dean, R&D, IIT Patna
2. Advertisement file
3. Project file