Proposal for Young Scientist IAPWS Fellowship Project

Towards an IAPWS Guideline for the Thermodynamic Properties of Supercooled Heavy Water

IAPWS Sponsors

Mikhail A. Anisimov
Institute for Physical Science and Technology
and Department of Chemical and Biomolecular Engineering
University of Maryland, College Park, MD 20742, USA

Jan Hrubý
Institute of Thermomechanics of the CAS, v. v. i.
Academy of Sciences of the Czech Republic
Dolejškova 1402/5
CZ-18200 Prague 8
Czech Republic

Young Scientist

Michal Duška
Institute of Thermomechanics of the CAS, v. v. i.
Academy of Sciences of the Czech Republic
Dolejškova 1402/5
CZ-18200 Prague 8
Czech Republic

June 29, 2015

Abstract

Support is requested for an IAPWS Fellowship for a young scientist, Michal Duška, to pursue research "Towards an IAPWS guideline for the thermodynamic properties of heavy supercooled water"

1. Introduction

During the past decades considerable amount of experimental information for thermodynamic properties of supercooled heady water has become available. These experiments have revealed the anomalies similar to those observed in supercooled ordinary water. One theoretical possibility is the suggested presence of a metastable liquid-liquid critical point in supercooled water.

In a previous project supported by IAWPS a fundamental equation for the Gibbs energy as a function of temperature and pressure of state for cold and supercooled liquid H_2O (ordinary water substance) was developed in this guideline is a fundamental equation for the Gibbs energy as a function of temperature [1]. A draft of Guideline on Thermodynamic Properties of Supercooled Water, based on this equation, was presented to IAPWS for further consideration.

The project proposed will not only enable IAPWS to be actively engaged in a subject of considerable contemporary scientific interest , but it is also of direct relevance to IAPWS, since the equation of state of heavy water has been recently presented. We do think it should be possible to develop a reliable guideline for the thermodynamic properties of supercooled heavy water at least in the range of temperatures and pressures of direct relevance to an IAPWS.

2. Young investigator

We have found a young scientist, Michal Duška, from the Technical University Eindhoven who is uniquely qualified to pursue this research. The Curriculum Vitae of Michal Duška was provided.

3. Implementation of project

We request IAPWS support for a 9-months stay of Michal Duska at the University of Maryland from September 1 2016 till May 31, 2017. A report on the research to be completed under this project will be reported at the 2017 annual meeting of IAPWS and at the following Water Conference.

2. Budget (in £ GBP)

Subsistence for 9 months: IAPWS Young Scientist Grant..... £17,490

References

[1] Holten, V., Sengers, J.V., and Anisimov, M.A., Equation of state for supercooled water at pressures up to 400 MPa, *J. Phys. Chem. Ref. Data* **43**, 043101 (2014)

Attachment: Curriculum Vitae of Michal Duška

Proposal for IAPWS International Collaboration

D. Addison & W. Cook
New Zealand and Canada
29th June 2015

Overview:
IAPWS ICRN #25 [ref. 1] describes the need for high temperature data on the effects of combined anion contamination on the corrosion of boiler materials. Industry guidelines (i.e. IAPWS TGD's) specify administrative and action limits for Cl^-, SO_4^{2-}, etc. to prevent corrosion, impurity concentration and under-deposit corrosion; however, most of these limits are not fully validated by rigorous experimental evidence. The intent of this International Collaboration project would be to capitalize on previous development of electrochemical corrosion sensors (for example, see ref. 2) for use in simulated boiler/evaporator water and to establish and commission the facility and methods required to conduct targeted, long-term testing for materials in conventional boilers, HRSG's, industrial plants, and nuclear steam generators.

Scope:
Design and construct two-electrode and/or three-electrode high-temperature electrochemical flow-through cell. Similar to work conducted and described in reference 2. Collaborative effort between W. Cook and D. Addison – primarily through correspondence (first six month period).

Upgrade test loop at UNB, install and commission electrochemical test system. Run baseline testing to verify and validate experimental method. Collaborative effort between W. Cook and D. Addison. D. Addison to reside at UNB over six months (in 6-8 week periods) to assemble and commission flow-through electrochemical cell and to conduct base-line tests. (second six month period)

Deliverable: Report describing commissioning and preliminary baseline testing results from UNB high-temperature test rig with flow-through electrochemical cell. Intent is to have system and method ready for ongoing, long-term test program.

Budget:

Travel:	£ 4,600	
Accommodations:		£ 3,000
Incidentals:		£ 2,000
Total:		£ 9,600

References:
1. IAPWS ICRN#25, "*Corrosion mechanisms related to the presence of contaminants in steam/water circuits, particularly in boiler water*".
2. Victor Balashov, Mark Fedkin, Serguei Lvov, Barry Dooley, "*Experimental System For Electrochemical Corrosion Studies In High Temperature Aqueous Solutions*", NACE-07403, Corrosion 2007, March 2007.