



上智大学
SOPHIA UNIVERSITY



Sophia University
Graduate School of Global Environmental Studies (GENV)

Dear Dr. Rubin Philip

First of all, let me thank you for your collaboration with regard to wetland study in Kerala, which is part of Sophia Research Branding Project. As a leader of the project, I deeply appreciate your commitment and efforts toward better understanding wetland ecosystems in Kerala.

We now plan to have a symposium to discuss flood disaster management and wetland conservation in Kerala at Sophia University on Oct. 18. We would like to invite you to deliver a keynote speech about wetland in Kerala at the symposium. The period of your stay in Tokyo will be from Oct. 16 to 20. I know you have a busy schedule, so your consideration of participation in this symposium will be highly appreciated. If you can join, we will be more than happy to cover all the travel cost.

Best regards

Guangwei Huang

PhD, Professor

Graduate School of Global Environmental Studies,

Director of the Institute for Studies of the Global Environment

Sophia University, Japan

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Japan Science and Technology Agency (JST)
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Letter of Certificate

August 1, 2019

Mr. NITHIN VARGHESE
St. Berchmans College
INDIA

Dear Mr. NITHIN VARGHESE,

This is to certify that you have been chosen to join an invitation program carried out under the framework of SAKURA SCIENCE Exchange Program (Sakura Science Plan) administered by Japan Science and Technology Agency.

The invitation program is as follows.

The host (implementing) organization:

Sophia University

The program dates (Dates of Entry to and Departure from Japan):

October 12, 2019 through October 21, 2019

JST looks forward to welcoming you to Japan.

Yours sincerely,

黒木 慎一

Shinichi Kuroki,

Director

Department of Sakura Science

China Research and Sakura Science Center

Japan Science and Technology Agency



Article

Temperature Dependent Structural Evolution of WSe₂: A Synchrotron X-ray Diffraction Study

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Abstract: A thorough investigation of the structural parameters of micromechanically exfoliated multilayer WSe₂ flakes was undertaken between 400 K to 110 K. Crystal structure of WSe₂ remains in the trigonal prismatic structure in this temperature range, however, with a clear difference in the temperature dependence of the in-plane *a*, and the out-of-plane *c*, lattice parameters. The linear coefficients of thermal expansion of *a* and *c* are $5.132 \times 10^{-6}/\text{K}$ and $8.105 \times 10^{-6}/\text{K}$, respectively. The temperature dependence of the unit-cell volume is analyzed using zero-pressure equation-of-state which yielded the Debye temperature of the WSe₂ to be 160 K. Following the temperature dependence of the W-Se and W-W bond distances, a nonlinear behavior is observed in the former in contrast to a rather regular behavior of the later. This significant difference in the temperature dependence of the *a* and *c* lattice parameters can have consequences in the macroscopic physical properties of the system. A good correlation between the temperature dependence of the W-Se bond distance and Raman E_{1g} mode has been observed.