Exploring new materials for future energy-saving society

Tajikistan-Japan collaboration to develop functional materials for next generation solar cells

Funded by Japan

SDGs

PhTI NAST(TJ)

Physical-Technical Institute, National Academy of Sciences of Tajikistan

Project: **TJ-2726**

Waseda University(JP)

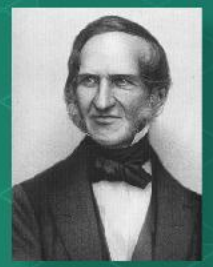
Faculty of Science and Engineering, Institute of Condensed Matter Sciences

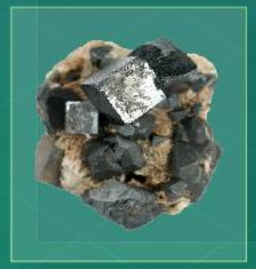
What is Perovskite solar cell (PSC)?

- Energy resources are necessary for mankind to maintain a safe and convenient life on Earth. Electricity is one of the most essential resources, but burning fossil fuels to generate electricity emits carbon dioxide, which accelerates global warming. Efficient use of renewable energy sources such as solar and hydroelectric power is therefore effective.
- Perovskite solar cell (PSC) is a new type of solar cell that can solve the problems in the conventional solar cells until now. This project aims to explore new materials while removing harmful substances from the materials in PSC and enables more secure long-term use of current PSCs.
- PSC is a type of solar cell that uses perovskite materials as the photo absorption layer and convert sun light into electrical energy. Perovskite is a name of mineral, which was discovered in 1839 in the Ural Mountains by Gustav Rose and was named after the statesman, mineral collector, senator Lev Perovsky.
- PSC was first developed in 2009 by Japanese researcher, Prof. Tsutomu Miyasaka, Toin University of Yokohama.

Perovsky Lev Alekseevich
(1792-1856)

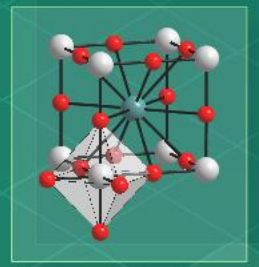
Gustav Rose
(1798-1873)





Crystals of perovskite on matrix
Size (mm): 23×21×20

Perovskite structure
(turquoise - calcium, gray - titanium, red -oxygen)



Example of a perovskite thin film.
(Synthesized in PhTI NAST)

PSC with Prof. Tsutomu Miyasaka

Introduction | Purpose | Scope Of Activities | Outcome

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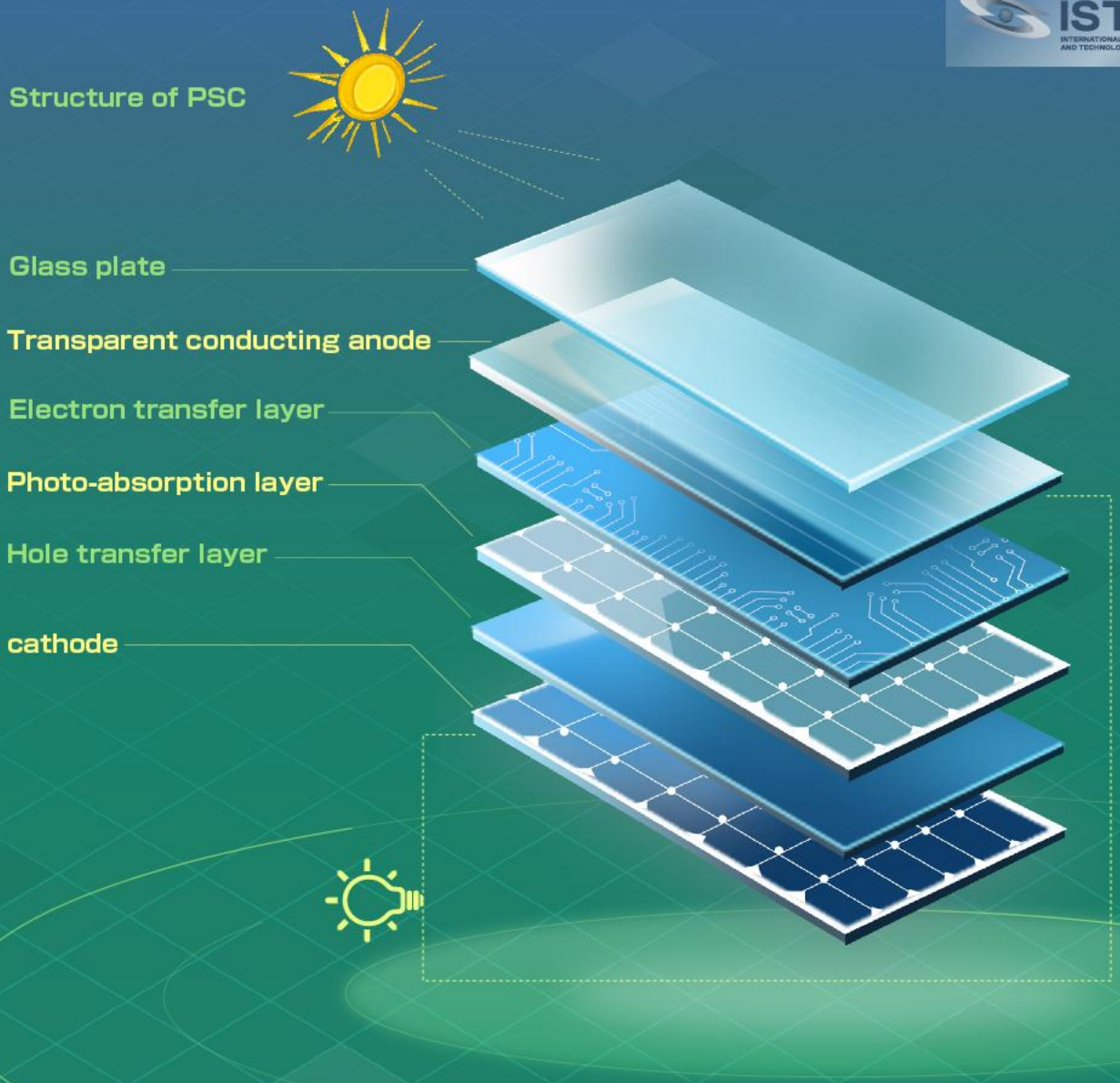
Why is PSC called next generation solar cell?

- Current solar cells are made with Si-based wafers, but they have some disadvantages for sustainable society.

Production Cost　Flexibility　Weight　Recyclability

- PSC can overcome some of these problems, then PSC is called next generation solar cell.
- PSC has a film stacking structure, and each film can be synthesized with coatings of solutions, which makes fabrications much easier than that for conventional solar cells.

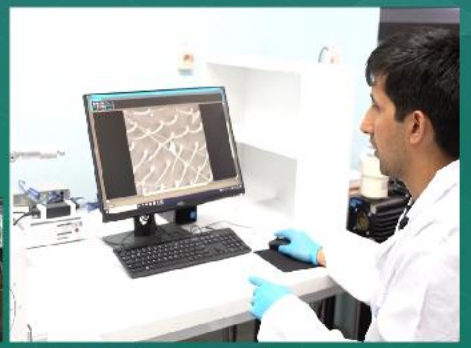


Objective of the research project

- Current photo absorption layer materials of PSC contain lead,which is toxic and can have negative impacts on the environment and people if not properly treated during production and disposal. One of the main purposes of the Tajikistan - Japan research group is to replace the lead by other environmentally friendly elements.

- The research group succeeded in synthesizing some of the films to develop new types of PSCs without any toxic elements.

Newly installed equipment in PhTI supported by ISTC



- Computer simulations in an atomic scale and machine learning technique were also applied to develop new materials for efficient PSCs.

High performance computer in PhTI

Active international research collaboration

- Young researchers of PhTI, NAST visited Waseda Univ. , performed various experiments with local students and researchers and participated in different workshops and seminars.

Joint research in Waseda Univ





- Results of the joint studies have been presented in the international conferences and published in the international scientific journals.
- This joint project has mutual benefits for both sides as it fosters exchange of ideas, mobility of researchers and shared expertise while it allows Tajik young researchers to experience cutting-edge research infrastructure in Japan.


Visit of Prof. Tomoyuki Yamamoto to the PhTI, NAST and participation in scientific seminars

Meetings with the President of NAST, Director of PhTI (September 2023)


What is the application of the research results and how will the new materials benefit society?

- Tajikistan has abundant water resources and can generate hydroelectric power to meet 95% of the country's electricity needs, but in order to transmit electricity to mountainous areas far from hydroelectric power plants, it is necessary to install and maintain transmission facilities. By using solar cells with environmentally friendly high-efficient elements developed by this project, it is possible to generate and use electricity where it is needed, even in places around the world far from hydroelectric and other renewable energy power plants.

Hydropower station in Tajikistan

TJ-2726 research group

Responsible Executor

Dr. Z. Umar

Consultant

Ass. Prof. F. Shokir

Responsible Executor

Dr. U.J. Rahimova

Responsible Executor

Ass. Prof. M.S. Kurboniyon

The project research team includes

1 Prof., **2** Ass. Prof.,

7 PhD and engineers

Project Manager

Dr. D.D. Nematov

Leading Specialist

Dr. A.S. Burhonzoda

Project Scientific Leader

Prof. Kh. Kholmurodov

Responsible Executor

Dr. Sh.Kh. Khalifaeva

Responsible Executor

Dr. M.M. Kayumov

Responsible Executor

Dr. I.M. Raufov

Waseda University - 2023

PhTI NAST - July 24, 2024

PhTI NAST - April 26, 2024

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With the support of ISTC, we have successfully completed our third internship at Waseda University,
ISTCの支援を受けて、私たちは早稲田大学で3度研修を受けました
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