Advanced Core for Energetics, Hiroshima University Vol. 101

HU-ACE NEWS LETTER

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Activities of the Core

May. 27, 2025 The 121st Hiroshima University Biomass Evening Seminar (co-organized by HU-ACE)

May. 29, 2025 The 103rd HU-ACE Steering Committee Meeting

Status of the Ground Thermal Energy Seminar

HU-ACE holds online seminars on ground thermal energy utilization once every three months, starting with the first one by Prof. Katsunori Nagano of Hokkaido University in October 2022, followed by 10 seminars so far. Lecturers were invited not only from universities and research institutes but also from local governments and private companies. They openly discussed the latest technologies and issues to be solved for widespread ground thermal energy utilization. The term “ground thermal energy utilization” covers a wide range of applications, including the use of boreholes and foundation piles as the heat source for heat pumps, the use of aquifers for seasonal heat storage, and its use for hot-water supply and agricultural applications rather than air conditioning. In other words, the system solution varies depending on the location, building usage, and other constraints, which makes ground thermal energy both challenging and interesting. The seminars have been attended by many people interested in renewable energy in general. The Q&A session via online chat has also been well received. We look forward to your continued warm support.

Record of the Ground Thermal Energy Seminars (1st to 10th)

No.	Date	Lecturer	Affiliation	Title
1	Oct 2022	Prof. Katsunori Nagano	Hokkaido University	Global Trends in Geothermal Utilization and R&D for Cost Reduction and Advancement at Hokkaido University
2	Jan 2023	Dr. Yuichiro Amano	Shikoku Electric Power Co., Inc.	Practical Case Studies of Renewable Energy Use Including Geothermal Energy at Shikoku Electric Power
3	Apr 2023	Dr. Yasuhisa Nakaso	Osaka Metropolitan University	Aquifer Thermal Energy Storage: Utilization of Groundwater Heat in Urban Areas
4	Aug 2023	Assoc. Prof. Sayaka Kindaichi	Hiroshima University	Role of Geothermal Energy in a Carbon-Neutral Society in Warm Regions
5	Nov 2023	Dr. Yasushi Nakamura	Nippon Steel Engineering Co., Ltd.	Implementation of Geothermal Systems at Nippon Steel Engineering: From Foundation Piles to Individual HVAC Solutions
6	Feb 2024	Prof. Hideki Tanaka / Dr. Masaki Shioya	Nagoya University / Kajima Corporation	Performance Evaluation of Loop-type Ground Source Heat Pump Systems Using SSHP
7	May 2024	Dr. Shiro Tsukami	Nikken Sekkei Ltd.	Examples of Geothermal and Renewable Energy Use from a Designer’s Perspective
8	Sep 2024	Dr. Takashi Ishikami	Mitsubishi Materials Techno Corporation	25 Years of Geothermal Initiatives at Mitsubishi Materials Techno
9	Dec 2024	Mr. Kuniharu Tanaka	City of Osaka	Efforts by Osaka City to Promote Geothermal Energy (Aquifer Thermal Storage Systems)
10	Mar 2025	Dr. Akira Tomigashi	AIST	Social Implementation of Geothermal Energy and Creation of a Thermal Utilization Consortium

Related Events

Jun.26, 2025: The 11th Ground Thermal Energy Seminar (co-organized by HU-ACE) ※Please note: This seminar is conducted in Japanese only.

Jun. 30 - Jul. 1, 2025: The 9th International Symposium on Fuels and Energy (ISFE2025)

Contact us for more information : hu-ace-info@ml.hiroshima-u.ac.jp

Research consultation and joint research are welcome.

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Do You Know Energy? No. 2

Cellulose nanofiber

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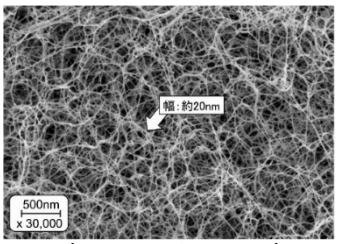
Research fields:
Cellulose Chemistry, Wood Chemistry, Polymer Chemistry.

Keywords:
Cellulose-based functional/composite materials, nanocellulose, biofuel

What is Cellulose Nanofiber?

Cellulose nanofiber, often called CNF, is a super-fine fiber made from plants like wood. Plants are mainly made up of cellulose, hemicellulose, and lignin. Both cellulose and hemicellulose are built from sugar molecules, and cellulose is made entirely from glucose. In nature, cellulose molecules don't exist on their own—they group together naturally to form tiny fibers at the nanometer scale. These fibers stick together thanks to hydrogen bonds and other molecular forces, and they help make wood and other plant materials strong. CNF is created by mechanically or chemically breaking down plant material to pull out just those fine cellulose fibers. They're incredibly thin—just 3 to 20 nanometers wide.



Electron micrograph of wood-derived CNF

How is Cellulose Nanofiber Produced?

In wood and similar materials, CNFs are tightly packed in layers and held together by hemicellulose and lignin. But since they're only physically stacked, it's possible to separate them. Plants are naturally built to resist being broken down, but if we apply shear force or use light chemical treatments to weaken the bonds, we can break apart the structure and get CNFs out. This process is done in water, so the result is a kind of watery, creamy gel full of CNF. If you just dry it with heat, the fibers clump together and lose their properties, so special techniques are used to keep them in good shape.

Why is Cellulose Nanofiber Important?

CNF is made from renewable resources like wood, which absorb CO_2 as they grow, making it an eco-friendly material. One of the coolest things about CNF is its strength: it's about five times stronger than steel, yet only one-fifth the weight. That makes it great for mixing into plastics or rubber to make lightweight, high-performance materials. Plus, since CNF is thinner than the wavelength of light, it can even be used to make transparent materials. It's also tasteless, odorless, and non-toxic, which means it can be used in food products too. These are things that traditional synthetic materials can't really do, so CNF is getting a lot of attention as a key material that supports sustainable development goals (SDGs).

What Are the Future Prospects for Cellulose Nanofiber?

While CNF has a lot of promising features, the main challenge right now is cost. The raw materials, like wood, are pretty cheap, but because CNF is made with a lot of water and needs special processing, it tends to be expensive. People are working on ways to bring the cost down, but until then, it's important to use CNF in ways that make the most of its performance. In some cases, using it in plastic products might not be cost-effective, but thanks to its safety and natural origin, there's a lot of potential for CNF in areas like medicine, food, and cosmetics.