PRESS RELEASE

July 7, 2025

Chiyoda Corporation
New Energy and Industrial Technology Development Organization (NEDO)

Development of Large-scale Production Technology for Useful Proteins Using Plants

Launch of a 'Plant Biofoundry' - a Demonstration Platform in the Field of Bio-manufacturing

Chiyoda Corporation (Chiyoda) has successfully developed foundational technology for producing useful substances using plants, as part of NEDO's project 'Development of Bio-derived Product Production Technology to Accelerate Carbon Recycling'. The project demonstrates the production of human type II collagen, the first of its kind globally, as a model protein for the production of useful substances. Utilizing plants allows for animal-free and cost-effective production of products, such as vaccines, pharmaceuticals, regenerative medicine products, cosmetics and functional foods, while reducing greenhouse gas emissions.
This facility, Japan's first 'Plant Biofoundry', is dedicated to the practical development of plant bio-manufacturing and will support research and development from third party institutions and companies. This will be showcased at Chiyoda's booth during the 'INTERPHEX Week Tokyo / Regenerative Medicine EXPO Tokyo' held at Tokyo Big Sight from 9 to 11 July, 2025.

Figure 1: Exterior of the Plant Bio Demonstration Facility and Plants Under Cultivation

1. Background

The technology for producing materials using living organisms such as plants and microorganisms (bio-manufacturing) is more energy-efficient and does not rely on fossil resources. It is expected to transform manufacturing that contribute to a carbon-circular society and sustainable economic growth. Challenges remain however, including lower production efficiency compared to petroleum-derived products and inferior physical properties of bio-products.

While foundational technology demonstration facilities have been established for the production of useful substances using microorganisms, producing complex molecules with high molecular weights, such as those requiring post-translational modifications, is challenging with microorganisms. Conversely, plants are expected to enable the production of such useful substances, necessitating the urgent establishment of foundational technology demonstration facilities for plants.
In this context, NEDO has been implementing this project since fiscal year 2020. As part of the initiative, Chiyoda has collaborated with Nippi Corporation, Inc.(Nippi), the National Institute of Advanced Industrial Science and Technology (AIST) and the International Center for Biotechnology at Osaka University (ICB) since fiscal year 2022 on 'Development of Large-Scale Production Technology for Highly Modified Proteins Using Plants', to demonstrate the world's first large-scale production technology for human type II collagen using plants and building a foundational platform for bio-manufacturing with plants.

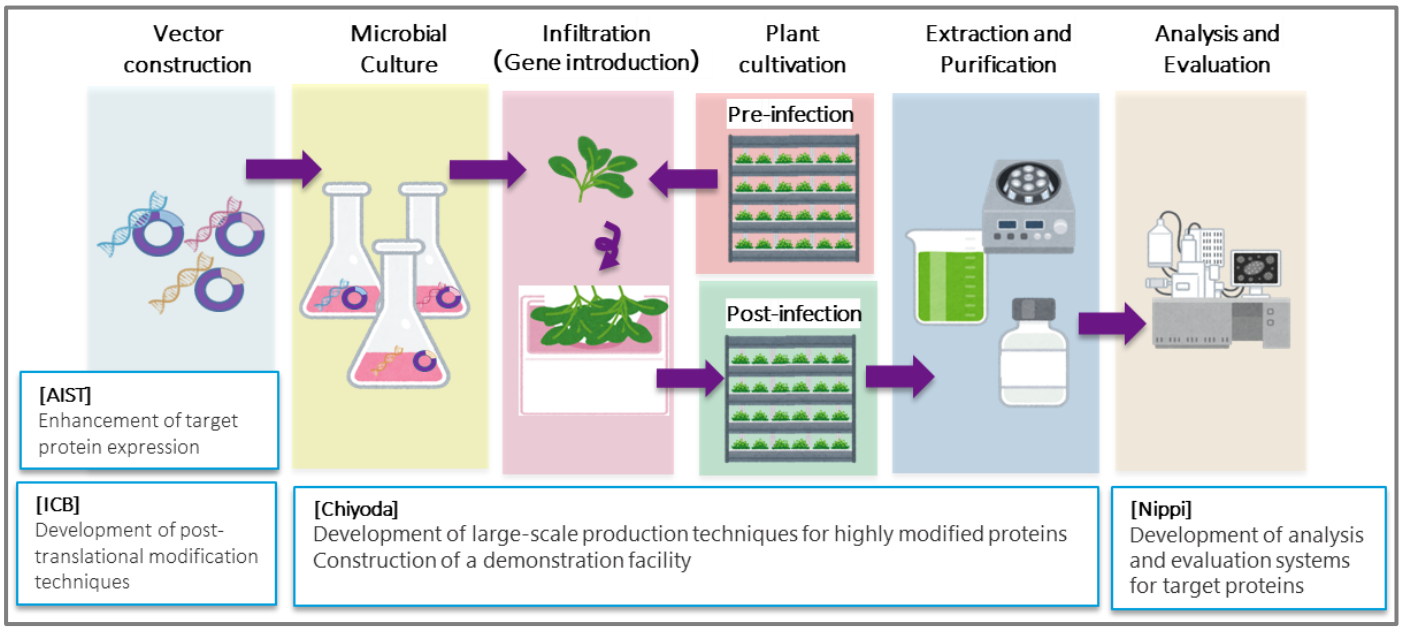
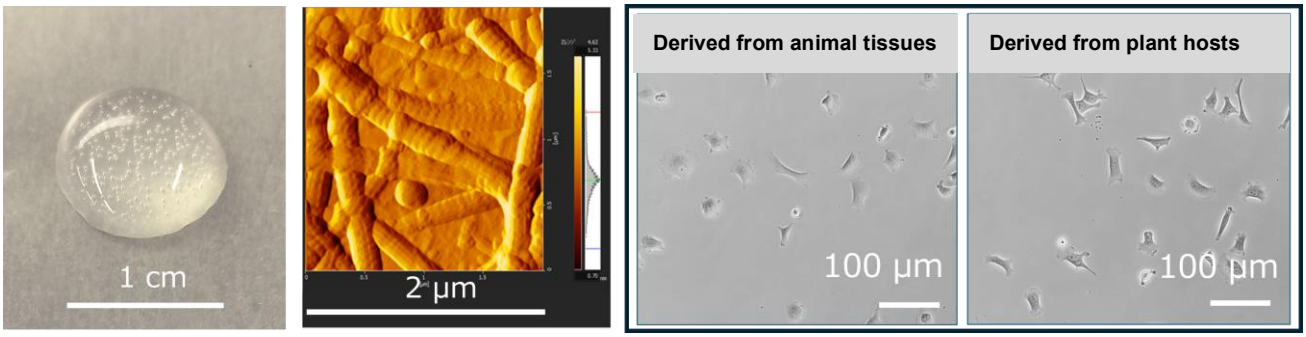


Figure 2: Development Overview

2. Development Achievements

Human type II collagen, a major component of cartilage, was selected as the model protein and collaborative research among the four parties focused on controlling the expression of type II collagen, post-translational modification enzymes and techniques for extraction, purification and analysis of the produced human type II collagen. By implementing the scale-up technology and large-scale production technology developed in the project into the foundational demonstration facility established by Chiyoda, production capabilities have expanded from several grams to tens of kilograms of plant biomass.
Human type II collagen requires complex post-translational modifications that are challenging to achieve in E. coli. The attempt to produce human type II collagen using genetically modified plants (animal-free) is a world-first. This development confirms that human type II collagen protein, which possesses properties similar to those of animal-derived products, can be produced using plants.
Furthermore, Chiyoda has commenced operations for the demonstration facility, aiming for operation

as a foundational platform for bio-manufacturing using plants.



(Left) Gel created using human type II collagen derived from plant hosts.
(Center) Atomic force microscope image of fibers created by reconstituting molecules.
(Right) Adhesion experiment of chondrocytes. Collagen derived from plant hosts shows similar adhesion activity to collagen derived from animal tissues.

Figure 3: Recombinant Human Type II Collagen Derived from Plant Hosts

Overview of the Plant Biofoundry

Introduction video URL: https://www.youtube.com/watch?v=d58m1T9Jsrk
Construction Location: Chiyoda Corporation Koyasu Research Park (Kanagawa Prefecture, Yokohama City)
Expected Functions: Support research and development of plant bio-manufacturing from third party institutions and companies, contributing to effective social implementation.
Services Offered as a Plant Biofoundry:

- Commissioned trials for material production using plants
- Process development for material production using plants
- Scale-up considerations from lab scale to bench/pilot scale
- Scale-up considerations from pilot scale to commercial scale
- Feasibility studies, etc.

3. Future Plans

Chiyoda will operate this demonstration facility as a ‘Plant Biofoundry’, providing support services for process development and sample production for useful substances developed by institutions and companies, aiming for practical application. The valuable experience and insights gained during this NEDO project will be utilized for future services, contributing to the advancement of the plant bio-manufacturing industry.
NEDO aims to increase demonstration examples of industrial material production systems, accelerating the social implementation of bio-derived products and creating new products and services, thereby contributing to the revitalization of Japan's bio-economy and the reduction of greenhouse gas emissions.

Notes:

1. **Project**
    - **Name:** Development of Bio-Derived Product Production Technology to Accelerate Carbon Recycling
    - **Duration:** FY2020 - FY2026 (planned)
    - **Overview:** Development of bio-derived product production technology to accelerate carbon recycling
    - NEDO Project Information
2. **Animal-Free**
    - Products that do not use animal-derived materials.

4. Contact Information

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