PRESS RELEASE

ZEON CORPORATION
1-6-2 Marunouchi, Chiyoda-ku, Tokyo 100-8246 Japan

December 26, 2023

Zeon, Nagoya University, and Friend Microbe Jointly Develop the World's First Method for Using Microorganisms to Degrade Carbon Nanotubes

Zeon Corporation

Tokai National Higher Education and Research System, Nagoya University

Friend Microbe Inc.

Zeon Corporation (Zeon; head office: Chiyoda-ku, Tokyo; President and CEO: Tetsuya Toyoshima), in collaboration with the research group of Professor Katsutoshi Hori of the Graduate School of Engineering at Nagoya University, Tokai National Higher Education and Research System (Chikusa-ku, Nagoya City, Aichi Prefecture; President: Naoshi Sugiyama), and Friend Microbe Inc. (Friend Microbe; Chikusa-ku, Nagoya City, Aichi Prefecture; President: Junichi Kanie), a startup launched by Nagoya University, have developed the world's first method for efficiently degrading carbon nanotubes (CNTs) using microorganisms. Before this breakthrough, conventional thinking had been that CNTs, an inorganic material composed of carbon, did not biodegrade in the environment. The latest result from the joint research not only overturns this belief but also raises the possibility of reducing the environmental risk of CNTs, and therefore it is expected that industrial use of this material will further accelerate.

Zeon developed single-walled carbon nanotubes (SWCNT; product name: ZEONANO®) with excellent properties in (1) aspect ratio, (2) specific surface area, and (3) purity and began commercial production at its Tokuyama Plant (Shunan City, Yamaguchi Prefecture) in 2016.

Since 2019, Zeon has been collaborating with Nagoya University and Friend Microbe on research focused on the biodegradability of CNTs, particularly SWCNTs. There had been reports of CNT degradation using the Fenton reaction*1, and we leveraged this knowledge to develop an efficient biodegradation method for SWCNTs using bacteria of the genus *Shewanella**2. The bacteria produce Fe (II) by reducing Fe (III) under anaerobic conditions and H_2O_2 by reducing O_2 under aerobic conditions, thus efficiently inducing the Fenton reaction. In our latest research, we applied this property to CNT degradation and subsequently confirmed that 56.3% of the CNT was degraded in 90 days. The result suggests that the Fenton reaction driven by *Shewanella* spp. can be applied to CNT degradation under a wide range of conditions and offer a promising new method for treating CNTs.

The research findings were published online*3 in the international academic journal *Frontiers in Microbiology* on November 30, 2023.

Roles of the Three Organizations in this Joint Research

Zeon Corporation	Provision of materials for single-walled carbon nanotubes and knowledge about the materials, expertise in chemical degradation, and evaluation methods for degradation
Nagoya University	Development and social implementation of new industrial technologies using microorganisms
Friend Microbe	Demonstration of a carbon nanotube management system

Since CNT degradation is crucial to managing the entire life cycle from manufacturing to disposal, Zeon has been proposing to relevant organizations a CNT management system based on the scientific evidence of degradation, and the fact that CNTs can be managed has attracted considerable interest. Zeon will contribute to a sustainable Earth and safe and comfortable life for people by promoting its SWCNT business.

*1 A chemical reaction in which H_2O_2 reacts with Fe ions to produce hydroxyl radicals, which are powerful oxidants. The Fenton reaction is used for the oxidative degradation of organic materials and detoxification of toxic substances, and it plays an important role in environmental engineering and wastewater treatment.
*2 A genus of bacteria found primarily in aquatic environments that is capable of using metal ions as electron acceptors in oxygen-deficient environments with the potential of being applied in the bioremediation of polluted environments and in bioenergy generation.
*3 Takahashi, S. and Hori, K. (2023). "Long-term continuous degradation of carbon nanotubes by a bacteria-driven Fenton reaction." *Frontiers in Microbiology*. https://doi.org/10.3389/fmicb.2023.1298323

For more information, contact:
Department of Corporate Communication, Corporate Sustainability Division, Zeon Corporation Phone: +81-3-3216-2747