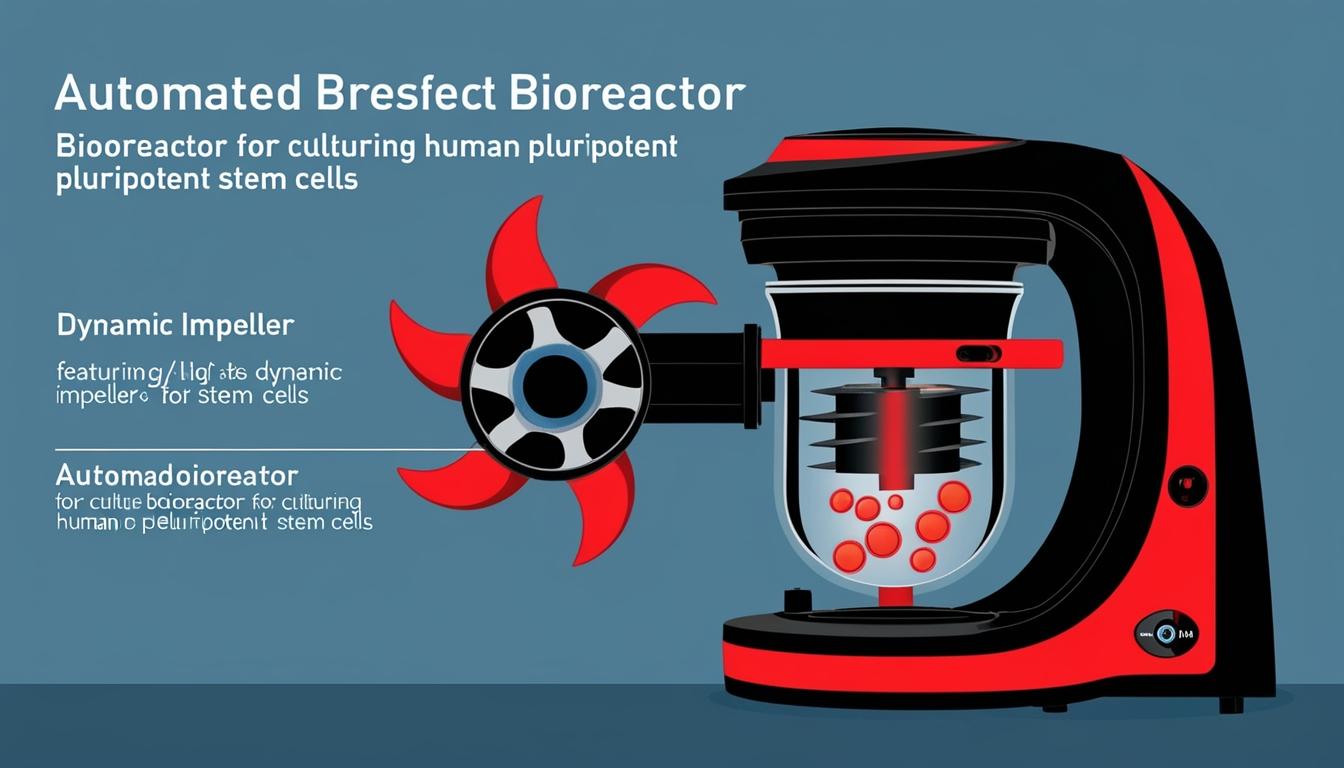
# Researchers develop automated bioreactor for human stem cell culturing



Researchers from the Fraunhofer Institute for Silicate Research (ISC) in Würzburg have made significant strides in the field of regenerative medicine with the development of an innovative bioreactor designed for the automated long-term culturing of human induced pluripotent stem cells (hiPSCs). This advancement is part of their ongoing research at the Fraunhofer Translational Center for Regenerative Therapies (TLC-RT) and addresses the pressing challenge of producing large quantities of hiPSCs, which have substantial potential in medical treatments, particularly for neurodegenerative diseases.

hiPSCs are created in laboratories through the reprogramming of adult cells, making them similar to embryonic stem cells but without the associated ethical challenges. These cells can turn into nearly any type of tissue, enabling not only therapeutic applications but also patient-specific testing for new drugs tailored to individual health conditions.

To cater to the increasing demand for hiPSCs and facilitate standardised production, the newly developed dynamic incubator, referred to as the SUSI (Suspension Incubator) project, offers optimal cultivation conditions. The incubator maintains a stable temperature of 37°C and a humidified atmosphere enriched with 5% carbon dioxide, essential for ideal cell growth.

A core feature of this cutting-edge bioreactor is its agitator or impeller, responsible for essential functions such as mixing, aeration, and ensuring uniform conditions within the cell culture. Speaking to Phys.org, Thomas Schwarz, a scientist at Fraunhofer TLC-RT, emphasised the importance of creating an environment favourable to cell health: "We focus on the good of the cells and designed and built all of the components of our bioreactor with that in mind."

The researchers employed software simulations to optimise the impeller's design and the corresponding process parameters. An array of sensors within the bioreactor continuously monitors these conditions, guaranteeing a homogeneous environment even when culturing large volumes of cells. The glass vessel that encases the impeller is designed to be scalable, allowing for adjustments according to the cultivation requirements.

A unique aspect of this bioreactor is a fluid loop that integrates four valves for the sterile transport of liquid solutions required for cell culture, thus facilitating full automation of hiPSC propagation and reducing human interaction risks. Additionally, the incubator is fitted with a specially developed microscope that continuously monitors the culture for any signs of unwanted cell clumping.

Incorporating artificial intelligence (AI), the system also includes a neural network that accurately counts the cells throughout the culture process. "Our modular system can be expanded to include additional functions and is distinguished by its flexibility and high degree of automation," noted Schwarz. The closed-loop design and automatic fluid exchange systems are pivotal in preventing contamination, a crucial concern in biological research.

The team has successfully utilised the prototype bioreactor to culture hiPSCs over a period of three months without compromising their differentiation potential. This ability to maintain cell quality and adjust for various types of cell differentiation marks a significant advancement in hiPSC technology, presenting broader implications for regenerative medicine and drug development.

As researchers continue to investigate the potential of hiPSCs, this automated bioreactor represents a notable leap towards scalable biomanufacturing processes, paving the way for enhanced therapeutic options in the medical field and potentially transforming business practices within biotechnology and pharmaceutical industries.

Source: [Noah Wire Services](https://www.noahwire.com)

## Bibliography

1. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Corroborates the development of the bioreactor for automated long-term culturing of hiPSCs by researchers at Fraunhofer ISC and TLC-RT.
2. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Explains the potential of hiPSCs in medical treatments, particularly for neurodegenerative diseases, and their creation through the reprogramming of adult cells.
3. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Details the optimal cultivation conditions provided by the SUSI project, including temperature and CO2 levels.
4. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Describes the role of the impeller in the bioreactor for mixing, aeration, and maintaining uniform conditions.
5. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Mentions the use of software simulations to optimize the impeller's design and process parameters.
6. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Explains the continuous monitoring by sensors to ensure a homogeneous environment and the scalability of the glass vessel.
7. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Describes the fluid loop and sterile transport of liquid solutions, and the integration of a microscope for monitoring cell culture.
8. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Highlights the modular system's flexibility, automation, and the use of a neural network for cell counting.
9. <https://www.fraunhofer.de/content/dam/zv/en/press-media/2025/january/isc-bioreactor-allows-automated-long-term-culturing-of-stem-cells.pdf> - Details the successful use of the prototype bioreactor to culture hiPSCs for three months without compromising their differentiation potential.
10. <https://www.regenerative-therapien.fraunhofer.de/en.html> - Provides context on the Fraunhofer Translational Center for Regenerative Therapies (TLC-RT) and its focus on regenerative therapies and scalable manufacture processes.
11. <https://www.fraunhofer.de/en/press/research-news/2025/january-2025/bioreactor-allows-automated-long-term-culturing-of-stem-cells.html> - Summarizes the significance of the bioreactor in addressing the challenge of producing large quantities of hiPSCs and its implications for regenerative medicine and drug development.
12. <https://phys.org/news/2025-01-bioreactor-automated-term-culturing-stem.html> - Please view link - unable to able to access data