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Electron beam and bioreactor working together

Fraunhofer FEP presents a novel hybrid technology that combines a low-energy electron beam source with a bioreactor. The plant, which has now gone into operation, is the first practical implementation of this innovation. The result is a flexible, scalable platform that opens up new possibilities for biotechnological applications – from resource-efficient metal extraction to sustainable environmental technology. The new technology can strengthen the National Bioeconomy Strategy by optimizing bioprocesses and making biological resources more efficient to use.

The hybrid technology developed at Fraunhofer FEP uses a low-energy electron beam source that is coupled to a bioreactor, allowing biological processes to be positively influenced in real time by accelerated electrons. This combination builds on Fraunhofer FEP's core competence in electron beam technology and expands its range of applications to include biotechnological processes.

The hybrid technology allows different volumes of liquid to be treated flexibly and energy-efficiently. Precise control of dose, dose rate, and penetration depth enables targeted influencing of bioprocesses. Installation and operation are space-saving and safe – ideal for sensitive areas of application. Thanks to its modular design, the technology is scalable and also suitable for larger bioreactor types in the future.

Bioleaching: Sustainable metal extraction from raw materials and residues

One forward-looking application example is bioleaching, i.e., the microbial extraction of metals from ores and residual materials. This involves the use of specialized microorganisms that extract metals such as copper, indium, or vanadium from poorly soluble metal sulfides or industrial residual materials. Bioleaching is considered particularly environmentally friendly because it does not produce toxic or climate-damaging emissions and requires significantly less energy than conventional processes.

Electron beam as an accelerator for bioleaching

The hybrid technology developed by Fraunhofer FEP sets new standards: initial investigations have shown that targeted irradiation of microorganisms with low-energy electrons can increase the efficiency of copper bioleaching by 10 percent. The results

show that the growth rate of the bacteria used is not impaired by low radiation doses – on the contrary: the yield of dissolved copper could be increased compared to untreated samples. This makes the recovery of valuable metals from low-grade ores or recycled materials more economical and sustainable. Research leader Prof. Dr. Simone Schopf is proud: "What fascinates me most is that we are using tiny organisms as miners and giving them an extra boost with electron radiation. This allows us to recover valuable metals from material that was previously considered waste – that's circular economy in action."

Wide range of applications

In addition to metal extraction, the hybrid technology is also suitable for other biotechnological and environmental applications, such as wastewater treatment, the production of biopolymers, or the sterilization of sensitive products.

Prof. Dr. Simone Schopf sees great potential in this development: "The combination of electron beam and bioreactor opens up completely new possibilities for specifically controlling biotechnological processes and increasing their efficiency. In this way, we are making an important contribution to securing raw materials and protecting the environment."

Fraunhofer FEP offers companies comprehensive support in the further development and implementation of hybrid technology. The range of services includes feasibility studies for specific applications, the establishment of test regimes for the treatment of microorganisms with accelerated electrons, the validation of process efficiency using recognized microbiological methods, and the investigation of the effect of electrons on various biological systems. With the commissioning of the new plant, scientists are now ready to work with partners from industry and research to exploit the potential of this innovative technology in various areas of application.

The innovative hybrid technology and its possible applications will be presented at the German Biotech Days 2026, from April 21 to 22, 2026, at the Fraunhofer FEP booth.

Fraunhofer FEP at the German Biotech Days 2026

April 21–22, 2026
Congress Hall at Leipzig Zoo
Booth no. G 09
www.german-biotech.day



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Development of hybrid technology for treating liquids with electrons

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