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Electron beam technology – innovative processes for environmental engineering

Applications based on electron beam processes and equipment that protect the environment and conserve natural resources are being developed at the Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP, one of the leading research and development partners in these fields.

Low-energy electrons are versatile tools used by scientists of Fraunhofer FEP for technologies that successfully kill bacteria, purify grey water of remnant hormonal and pharmaceutical substances, and even provide the basis for manufacturing vaccines. The processes employed are not only economical, but superior to other processes usually many times over in terms of their energy and resource consumption.

An innovative design for killing pathogens without the use of chemicals in agricultural seed inventories has been developed at Fraunhofer FEP this year that employs a toroidal electron source. This approach reduces the energy consumed and increases the economic efficiency of the process compared to others with two electron sources – especially in the case of low throughput. The basis for dressing seed inventory like this is the utilization of electrons that penetrate the harmful organisms and kill them effectively. Any influence of the electrons on the embryo and endosperm in the interior of the seed kernel can be demonstrably precluded. This technology will be available in the early part of next year already for industrial seed dressing in small to medium-sized quantities, including for organic agriculture.

Future research will concentrate on utilization of low-energy electrons for improving water quality by breaking down pharmaceutical impurities. Electrons can make an important contribution in this instance to pharmaceutical manufacturers on-site as well as to large-scale consumers of medications such as hospitals by breaking down substances like hormones and antibiotics effectively to make further cycling of water safe. Project Manager André Weidauer explains enthusiastically: “These electron-beam based processes have advantages in many respects compared to thermal or chemical treatment processes since they operate at an efficiency level of over 75% – and so are extremely energy-efficient. Compared to thermal processes, energy savings of over 70% are achievable.”

In addition to employing accelerated electrons in environmental engineering, this process can also be applied in other sectors. Scientists of Fraunhofer FEP have been conducting joint research with other partners within the association of Fraunhofer

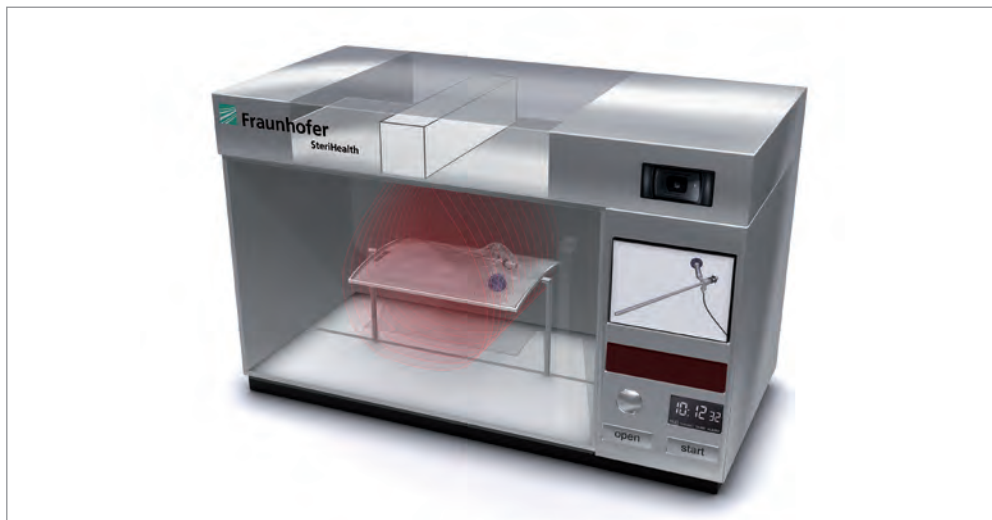
institutes on employing the technology in medical engineering and for sterilization. For example, LEEI (Low-Energy Electron Inactivation) is being used for especially delicate manufacture of vaccines. Innovative medical products (such as those with integrated electronics or novel combinations of materials) can likewise be sterilized effectively by low-energy electrons.

Work is also being carried out continuously on advanced development and optimization of the technologies themselves for new applications and to meet the requirements of our partners. The focus of development activities of Fraunhofer FEP is on linking ecological aspects of the technology with energy-efficient and economical design of processes for our clients. Scientists of Fraunhofer FEP look forward to new projects with industrial partners in order to make this pioneering technology useful for additional applications.



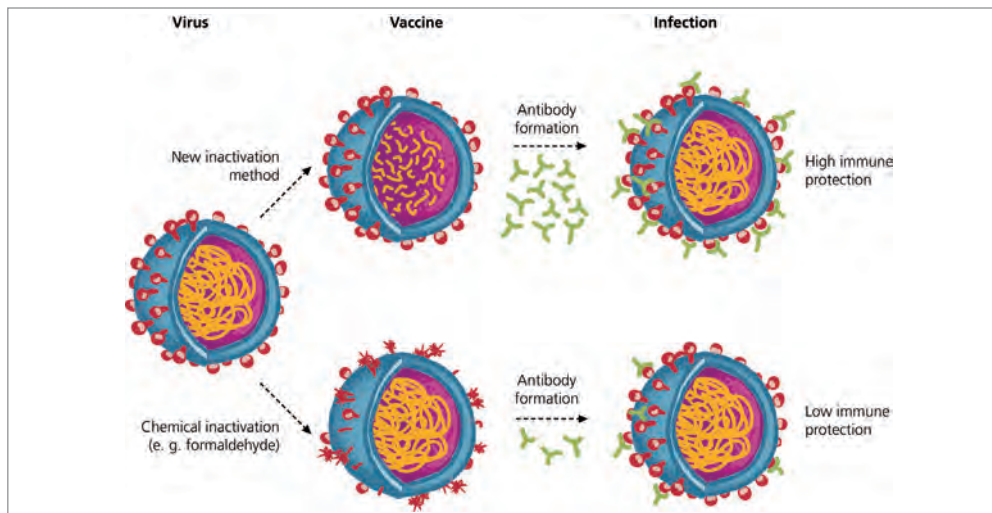
High-efficiency, compact, and mobile unit for on-site seed dressing

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Schematic scheme of a possible mini-sterilizer

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Schematic drawing for illustration of LEEI for vaccine production in comparison to the previously used method

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The **Fraunhofer Institute for Organic Electronics, Electron Beam and Plasma Technology FEP** works on innovative solutions in the fields of vacuum coating, surface treatment as well as organic semiconductors. The core competences electron beam technology, sputtering and plasma-activated deposition, high-rate PECVD as well as technologies for the organic electronics and IC/system design provide a basis for these activities. Thus, Fraunhofer FEP offers a wide range of possibilities for research, development and pilot production, especially for the processing, sterilization, structuring and refining of surfaces as well as OLED microdisplays, organic and inorganic sensors, optical filters and flexible OLED lighting. Our aim is to seize the innovation potential of the electron beam, plasma technology and organic electronics for new production processes and devices and to make it available for our customers. COMEDD (Center for Organics, Materials and Electronic Devices Dresden) with all known activities in organic electronics is now acting as a new business unit at Fraunhofer FEP, Dresden, Germany.