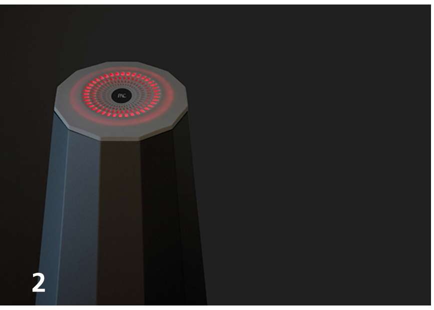
Cleaning of room air through plasma – PlasmaAirCleaner

Viruses spread particularly well in closed rooms via aerosols in the air. This means that the risk of infection increases when people are together in the same room. Rapid transmission of infectious diseases through aerosols in indoor air is a major problem, and the development of new and viable solutions for indoor-air purification is an important task, especially in the context of the current SARS-CoV-2 pandemic. The "PlasmaAirCleaner", or PAC for short, developed at the Fraunhofer IST in collaboration with HAWK, combines various approaches to cleaning indoor air in a low-maintenance, efficient and reliable manner. In this process, plasma, UV-C radiation and photocatalysis interact in the air-purification process to produce an optimum result.

1 *The plasma air purifier in activated carbon mode in a waiting room.*



2 *Red light signals the ozone mode has been activated.*

Challenge

The aim of the "PERFEKT" project was to develop a plasma air purifier that fulfills the function of air purification and, at the same time, enables surface disinfection, for example in hospital rooms. A special "bypass function" is intended to allow the room air flowing through the system to be directed either through the activated carbon or to bypass it. In "activated carbon mode", all guideline values for gas concentrations in the room must be observed. In "bypass ozone mode", on the other hand, the surfaces in the room are disinfected by outflowing ozone. The functionality is validated by measurements and flow simulations.

Operating principles of the plasma air purifier

After the air flows into the unit in a pre-filter stage, it passes through the axial fan and a cascaded, full-surface volume-plasma source consisting of 28 paired Al_2O_3 ceramic electrodes. These electrodes have been equipped with a photocatalytically active titanium dioxide coating, which ensures that the electrodes remain clean and sterile for optimal plasma discharge. The radiation required is generated by a UV cold cathode lamp with 254 nm wavelength and emitted by the plasma discharge itself.

Combined mechanisms of action: Air purification and surface disinfection in one device

Ozone-depleting UV-C radiation enables the amount of activated carbon in the unit to be reduced so that volume flow increases due to reduced flow resistance. The plasma air purifier thus enables extremely efficient air purification in operation (from 50 watts). In addition, the plasma air purifier can run very quietly. As soon as the bypass is opened, ozone flows out of the unit and enables disinfection of germ contamination on the surfaces in the room. Changing modes is easily performed via the app.

Outlook

The effectiveness and safety of the device have been investigated in extensive tests at the Fraunhofer Institute for Wood Research, Wilhelm-Klauditz-Institut WKI. Attention was paid both to compliance with all limit values in activated carbon mode and to reliable surface disinfection in ozone mode. The device must operate efficiently and also comply with the limit value for noise pollution. The clean air delivery rate – CADR for short – is determined as a meaningful value for competition purposes. Simulations determine the arrangement required for optimal disinfection effect in a given room geometry.

The project

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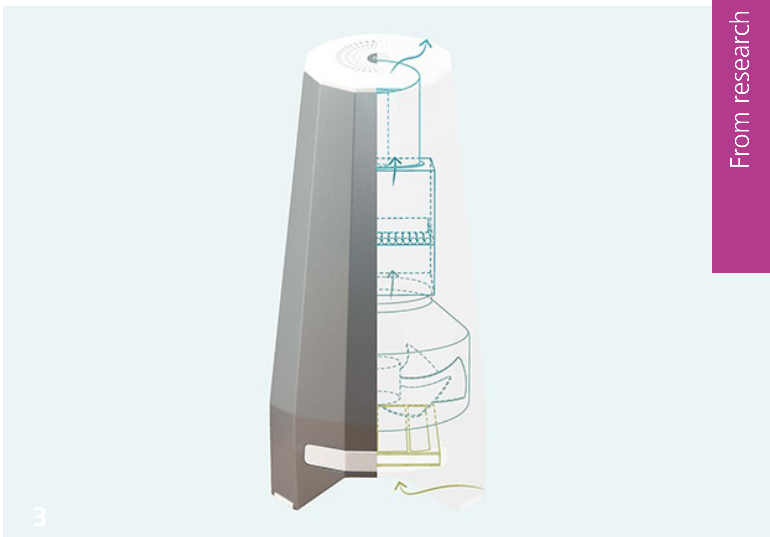
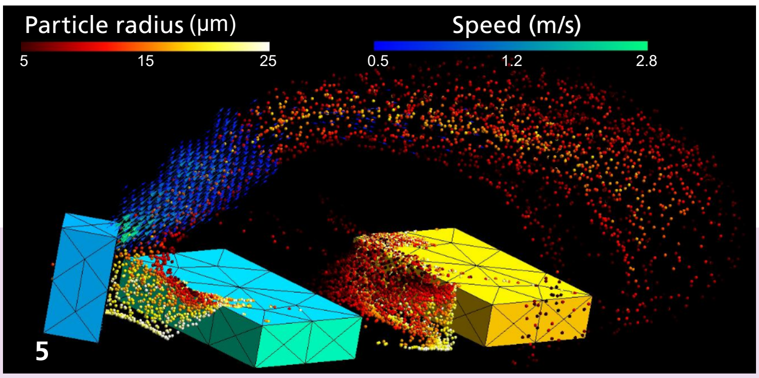


Technical components in the plasma air purifier.

The plasma air purifier in a waiting room.

3 GOOD HEALTH AND WELL-BEING

Simulation of particle flow in a hospital room with two beds and a PlasmaAirCleaner.



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