Easy Measurement of the Effect of Fine Dust

New Exposure System Determines Fine Dust Concentration in Lungs / Quick, Inexpensive, and Close-to-reality Replacement for Animal Experiments

The Karlsruhe Exposure System is compact and can measure fine dust concentrations directly at the location of pollution. (Photo: VITROCELL Systems GmbH)

Monika Landgraf
Chief Press Officer

Kaiserstraße 12
76131 Karlsruhe, Germany
Phone: +49 721 608-47414
Fax: +49 721 608-43658
E-mail: presse@kit.edu

For further information, please contact:

Kosta Schinarakis
PKM – Science Scout
Phone: +49 721 608 41956
Fax: +49 721 608 43658
E-mail: schinarakis@kit.edu

Fine dusts from industry, traffic, and households are omnipresent. Still, they are difficult to capture by reliable medical measurements. KIT researchers have now developed an exposure system, by means of which biological cells are exposed to fine dust-loaded air flows in an exact and reproducible manner. Using this system, it is possible to collect data on the adverse impact of fine dusts of variable sources in a rapid and inexpensive manner and without animal experiments being needed. In cooperation with the industry partner Vitrocell, a marketable product has been developed.

“Fine dusts may be carbon black from diesel engines, sea salt on the coast, natural dusts, or intermediate products of chemical industry,” Dr. Hanns-Rudolf Paur and Sonja Mülhopt of Karlsruhe Institute of Technology explain. All dust grains smaller than 10 µm, i.e. one hundredth of a millimeter, are considered to be fine dust irrespective of their chemical composition. Dust particles smaller than 10 µm easily pass the upper respiratory tract of man. “They deposit in the

pulmonary alveoli and may damage the lungs due to their chemical or physical properties."

To study the effects in detail, lung cells and fine dust have to be brought together in a realistic environment. Ultimately, the processes taking place in the human body from the nose to the lungs have to be reproduced. For this purpose, the air containing the fine dust is heated up to body temperature by the Karlsruhe Exposure System. The air flow is provided with about 85% humidity and reduced to the air flow rate of the lungs. For a long-term measurement series, these conditions have to be maintained exactly and reproducibly. Finally, the particle flow passes lung cell cultures cultivated with nutrient medium. Depending on the type of fine dust, these cultures subsequently show symptoms of inflammation, oxidation stress, or membrane damage. In parallel, the deposited particle dose is recorded by means of a precision balance.

The new Exposure System is much closer to reality than previous methods that collected fine dust from air or exhaust gas and stirred it into the nutrient liquid. At the same time, the Exposure System works more rapidly for many applications and is cheaper than a study based on animal experiments. Thanks to its compactness, the Karlsruhe Exposure System can also be used for measurements at the place of fine dust development or pollution. "The limitations of conventional methods were overcome by the close, interdisciplinary cooperation of biologists and process engineers at KIT," the Head of the project, Sonja Mülhopt, says. "With the Karlsruhe Exposure System, we now have a technology that will improve the protection of the environment and mankind."

"Research at KIT was the basis of a process with a high industry potential," Tobias Krebs of the company Vitrocell Systems (Waldkirch) says. "Together, we now plan to commercialize this product." The impact of fine dusts plays an important role in fundamental research as well as in many areas of application. According to the EU Directive on Chemicals REACH, chemical industry is obliged to classify its products in various hazard categories. Manufacturers of lung medicine, such as asthma sprays, are now enabled to test new substances in a close-to-reality manner. New and old biomass fuels may also be relevant fine dust sources.

The Karlsruhe Institute of Technology (KIT) is a public corporation according to the legislation of the state of Baden-Württemberg. It fulfills the mission of a university and the mission of a national research center of the Helmholtz Association. Research activities focus on energy, the natural and built envi-

ronment as well as on society and technology and cover the whole range extending from fundamental aspects to application. With about 9400 employees, including more than 6000 staff members in the science and education sector, and 24,500 students, KIT is one of the biggest research and education institutions in Europe. Work of KIT is based on the knowledge triangle of research, teaching, and innovation.

This press release is available on the internet at www.kit.edu.

The photo of printing quality may be downloaded under www.kit.edu or requested by mail to presse@kit.edu or phone +49 721 608-4 7414. The photo may be used in the context given above exclusively.