PRESS RELEASE

Fully automated: New Center for Digitally Networked Surface and Coating Technology opened at Fraunhofer IFAM

With the newly opened »Center for Networked Surface and Coating Technology«, Fraunhofer IFAM is researching the digital future of surface treatment using machine learning. On more than 750 square meters of technical center space with state-of-the-art equipment, the institute combines its expertise in the fields of cleaning, pretreatment, coating, and quality assurance for the automated processing of small and large structures. The central development goals here are fully automated process chains for robot-guided mobile and inline applications for series use.

Nowadays, fully automated and digital processes are the goal in the industrial treatment and processing of component surfaces – especially with regard to flexibility, process efficiency and quality assurance. The advantages and benefits are noticeable: costs are reduced, quality is improved, throughput rates are increased, and material savings and sustainability are realized. Last but not least, the occupational safety of employees is also increased.

The current challenge is the digital networking of all work steps in connection with the technology used in surface treatment and coating processes. The possibilities of automation and digitization have not yet been fully implemented in the area of surface processing and quality assurance.

In order to gain a better understanding of the entire process and to drive developments forward safely and quickly, the experts at Fraunhofer IFAM are looking at the entire value and process chain from the first inspection to the coated component. The process chain is digitally mapped and supplemented by interaction options using virtual and augmented reality. Research and development goals include the realization of digitally integrated surface technology systems and processes as well as process and quality optimization through machine learning and the use of AR/VR methods.

How virtual reality is becoming reality in industrial practice

Virtual reality, augmented reality, Internet-of-Things - digital tools and methods that link virtual models with real components are the applications of the future in surface treatment and coating processes. Properly implemented, they offer enormous potential for product development, process efficiency and quality assurance. Current challenges

Editor:
Dipl.-Biol. Martina Ohle | Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM | Phone +49 421 2246-256
Wiener Straße 12 | 28359 Bremen | www.ifam.fraunhofer.de | martina.ohle@ifam.fraunhofer.de

are the storage and management of relevant data, a creation of reliable models and resilient simulations, correct data provision and continuous data flow along the entire process chain, an automated inclusion of relevant data to optimize process steps and the integration of interfaces for collaborative machine interactions. Industry representatives immediately recognize the benefits of digital tools and methods. However, integrating the technologies into their own treatment and coating processes is extremely complex. This is precisely where the new "Center for Networked Surface and Coating Technology" comes in. With this holistic, application-oriented and practical offering for industry and research partners, processes can be selected according to requirements and optimized for individual production conditions. In addition, commercial coating processes can be simulated and optimized.

Development examples from practice: from surface inspection and treatment to the application process and quality assurance

Pretreatment with plasma technology and decoating with laser techniques are precision processes for preparing component surfaces for further processing, e.g. for bonding or coating. The slightest fluctuations in process parameters or starting substrates can have serious consequences, even leading to component failure. Surface pretreatment processes must therefore be extremely controlled. In order to counteract process fluctuations, Fraunhofer IFAM is researching into making these processes self-adjusting using optical and spectroscopic monitoring methods in combination with artificial intelligence, and thus making them safer.

In particular, controlling pretreatment processes with self-learning algorithms is one approach. In the first step, characteristic emissions of these processes, actual values of the process parameters and the resulting product properties are recorded using inline spectroscopic methods. The use of a high-resolution hyperspectral camera is suitable for this purpose, for example. In a second step, these data are linked with existing algorithms from the machine learning field as well as AI methods and correlations between these data are learned. Based on the knowledge gained, deviations in the process can be reliably detected in real time and countermeasures can be initiated to ultimately obtain a reproducible surface condition even with variable input variables, e.g. with process instabilities or variable initial conditions.

The subsequent coating process and, above all, the result depends not only on the pretreatment and coating material mentioned above, but also on the application technique selected. A wide variety of application systems are available on the market and often lead to a deviating appearance, even when an identical paint is used. One of the tasks of the center's scientists will be to investigate the influence of the application parameters on the appearance of a coating and use this knowledge to develop transferable prediction models. Among other things, a painting robot with a reach of over 2,600 mm and a payload of up to 45 kg is available for these tasks, so that it can also be used for paint technology issues from the aerospace industry.

Contact:
Björn Speckmann | Phone +49 421 2246-7171 | bjoern.speckmann@ifam.fraunhofer.de | Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM | Wiener Straße 12 | 28359 Bremen | www.ifam.fraunhofer.de

To safeguard processes and quickly determine material and production data, digital solutions for mobile and inline applications are being developed for quality assurance. Here, the focus is on the development of new measurement methods from laboratory application to use under real conditions. In particular, contactless spectroscopic methods in the short-wave infrared range and ultraviolet range are available here.

By digitally mapping the entire value chain and implementing artificial intelligence, the respective process steps can be better understood and transferred into physical models. Process parameters can thus be set as required for different components and surface conditions, interactions with subsequent process steps can be predicted, and the desired coating result can be achieved.

Further information
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Pictures

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Use of inline hyperspectral cameras for reliable detection of paint buildup in the aerospace industry. © Fraunhofer IFAM

Contact:
Björn Speckmann | Phone +49 421 2246-7171 | bjoern.speckmann@ifam.fraunhofer.de | Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM | Wiener Straße 12 | 28359 Bremen | www.ifam.fraunhofer.de

Laser paint stripping in combination with CO_2 snow cleaning for selective decoating and cleaning of ablation products. © Fraunhofer IFAM

View into the paint booth (back) and pretreatment booth (front) of the »Center for Networked Surface and Coating Technology«. © Fraunhofer IFAM

Plant control system of the »Center for Networked Surface and Coating Technology«.
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