

- 1 Damaged coating with microcapsules containing healing agents.
- 2 Healing agent being released from a broken microcapsule.
- 3 SEM micrograph of urea-formaldehyde microcapsules.

USE OF MICROCAPSULATED AGENTS IN COATINGS TO PROVIDE A SELF-HEALING EFFECT

Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM - Adhesive Bonding Technology and Surfaces -

Wiener Straße 12
28359 Bremen, Germany

Institute director
Prof. Dr. rer. nat. Bernd Mayer

Contact

Paint/Lacquer Technology
Dr. Claus Schreiner
Phone +49 421 2246-7160
claus.schreiner@ifam.fraunhofer.de

Dr. Volkmar Stenzel
Phone +49 421 2246-407
volkmar.stenzel@ifam.fraunhofer.de

www.ifam.fraunhofer.de

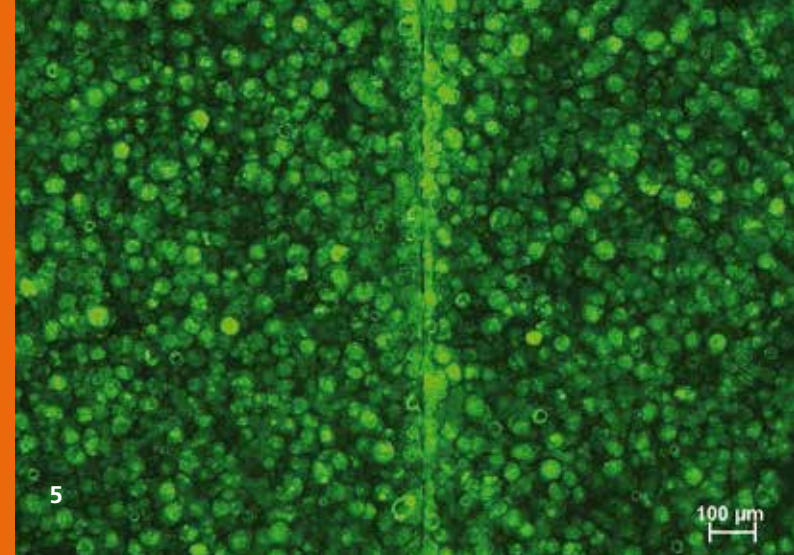
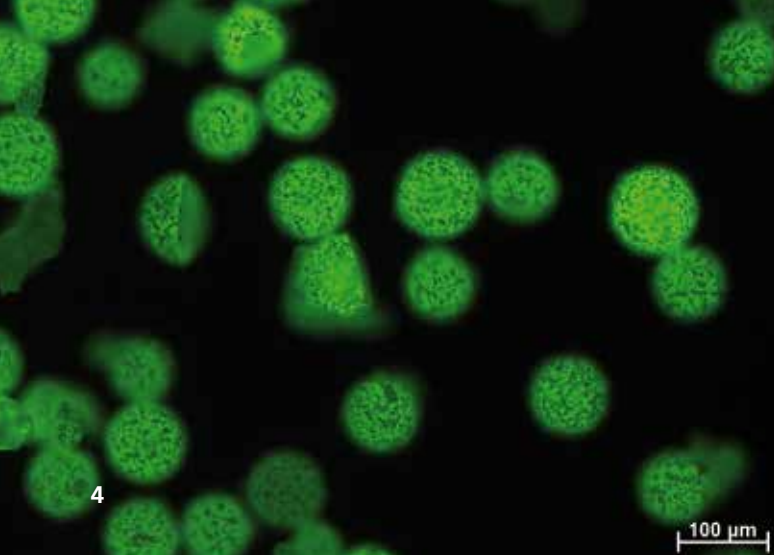
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Damage due to cracking

Very high demands are often put on coatings. The use of coatings on wind turbines is just one example of a structural healing. Wind turbines are exposed to enormous stresses from a combination of environmental effects and dynamic forces. This results in cracks in the coatings, which lead to weakening of the components. Corrosive media reach the substrate surfaces and cause damage. This means that maintenance is required more frequently and hence operating costs increase.

Self-healing coatings

The section Paint/Lacquer Technology at Fraunhofer IFAM is actively developing and testing self-healing coatings. This involves incorporating microencapsulated healing agents into a coating. When damage to the coating occurs (Fig. 1), the microcapsules are broken apart at that point. The healing agent is released (Fig. 2) and curing occurs in the damaged area. This mechanism allows cracks to be repaired, so preventing crack propagation and damage to the underlying materials.



Microcapsules in coating systems

Microcapsules can be manufactured from a wide variety of materials (Fig. 3). High requirements are put on microcapsules for use in coatings.

For the use in coating systems microcapsules must:

- be resistant to solvents
- be able to be dispersed, without the microcapsules being destroyed
- be able to be applied using spray guns, without the microcapsules being destroyed
- form a composite with the matrix
- break open on cracking of the coating and release the healing agent
- be stable to storage – in powder form and in the coating system –

In order to be sure that the microcapsules are suitable for use in coatings, they are characterized using a variety of tests:

- Determination of the mechanical stability
- Determination of the wall thickness
- Appraisal of the surface morphology
- Particle size distribution
- Analysis of the capsule contents
- Determination of the viscosity of the capsule contents
- Determination of the storage stability

Fraunhofer IFAM develops and characterizes customized microcapsules for coating systems.

Testing self-healing coatings

Fraunhofer IFAM designs and tests coatings that contain model microcapsules. After incorporation of the microcapsules into a coating system and application of the coating, the functioning of the coating must be tested.

The following tests are undertaken to characterize coatings:

- Evaluation of coatings after damage (optical microscope, confocal microscope, scanning electron microscope (SEM))
- Fluorescence labeling of the capsule contents followed by inspection under the fluorescence microscope (Fig. 4 + 5)
- QUV test for testing the stability to weathering
- Adhesion test for proofing the presence of a satisfactory composite between the microcapsules and the coating matrix

4 Fluorescence-labeled microcapsules.

5 Fluorescence-labeled microcapsules in a coating. Intense fluorescence can be seen along the crack.