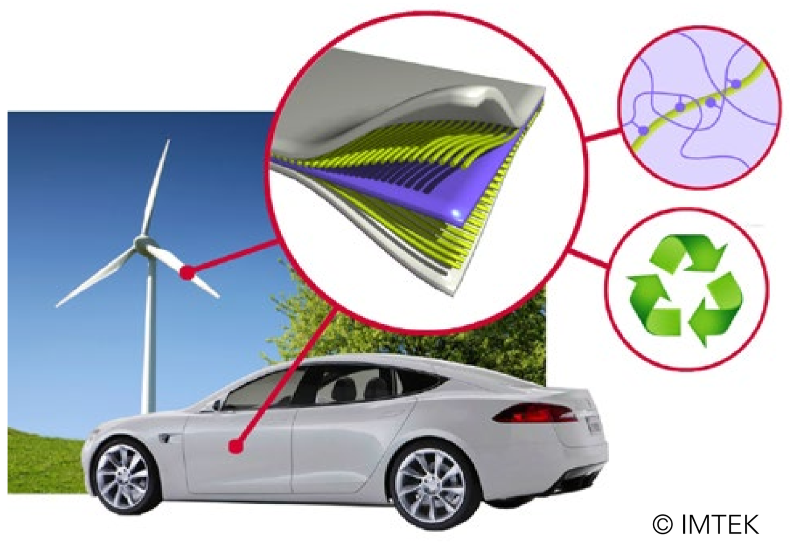
SUSTAINABILITY CENTER FREIBURG

CHEMICAL MODIFICATION OF FIBER-MATRIX INTERFACES FOR ENHANCING THE STRENGTH AND DURABILITY OF LIGHTWEIGHT CONSTRUCTION MATERIALS

Natural resources are limited, which triggers an increasing need for materials that can be produced without wasting natural resources and which reduce the use of energy and resources. Such lightweight materials are of specific importance in the transport sector because they reduce the weight of the vehicle, which in turn significantly reduces the amount of energy needed for each and every transport. Glass or carbon fiber reinforced polymers are well suited for such applications because they combine a low specific weight with a high stiffness and a high toughness. However, a good adhesion between the filler materials and the polymeric matrix is often a problem which jeopardizes the integrity of the hybrid material and its performance. Additionally, recycling is often problematic for such materials.



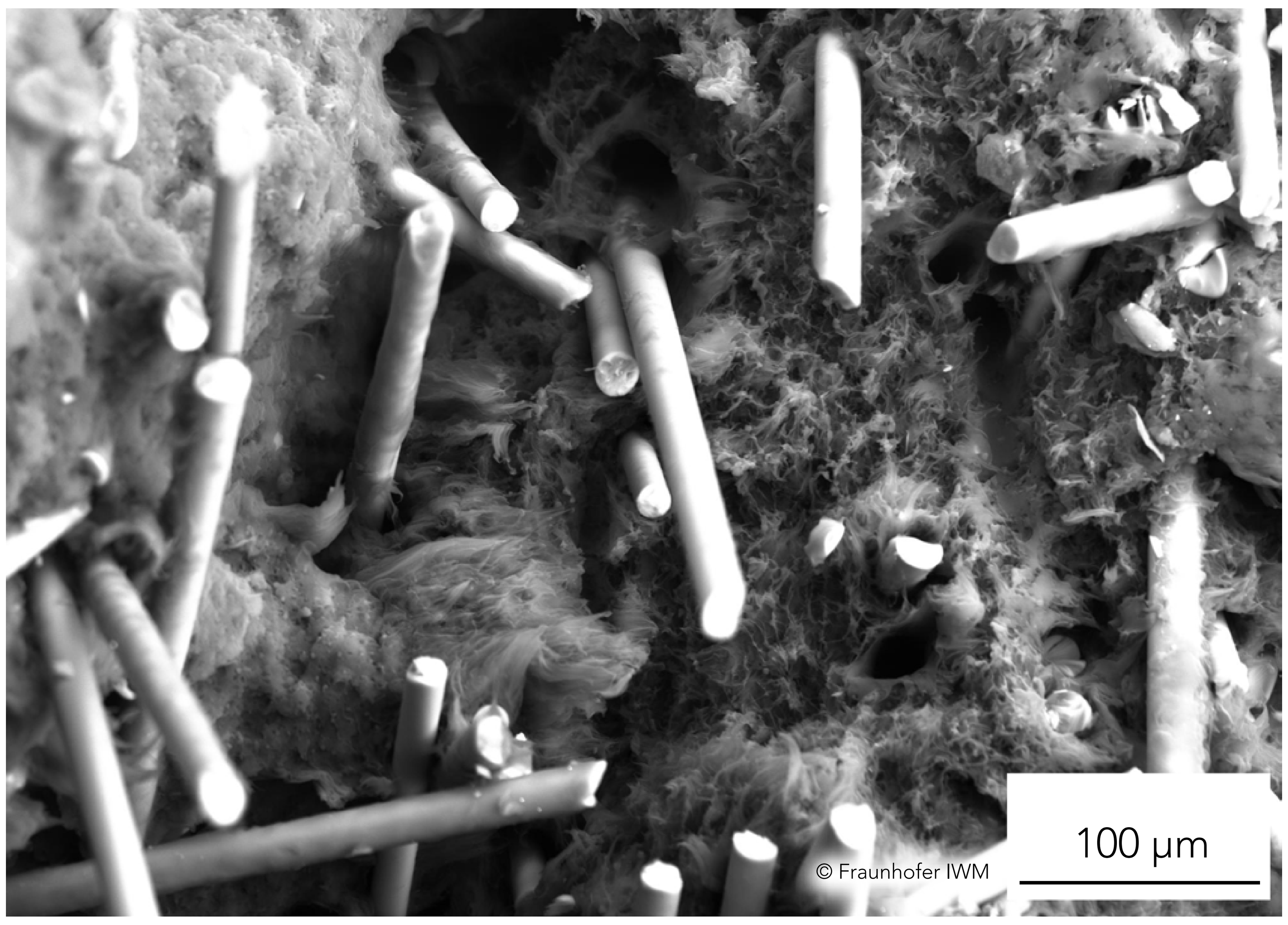


Figure 1: Fracture surface of a long fiber reinforced thermoplastic material.

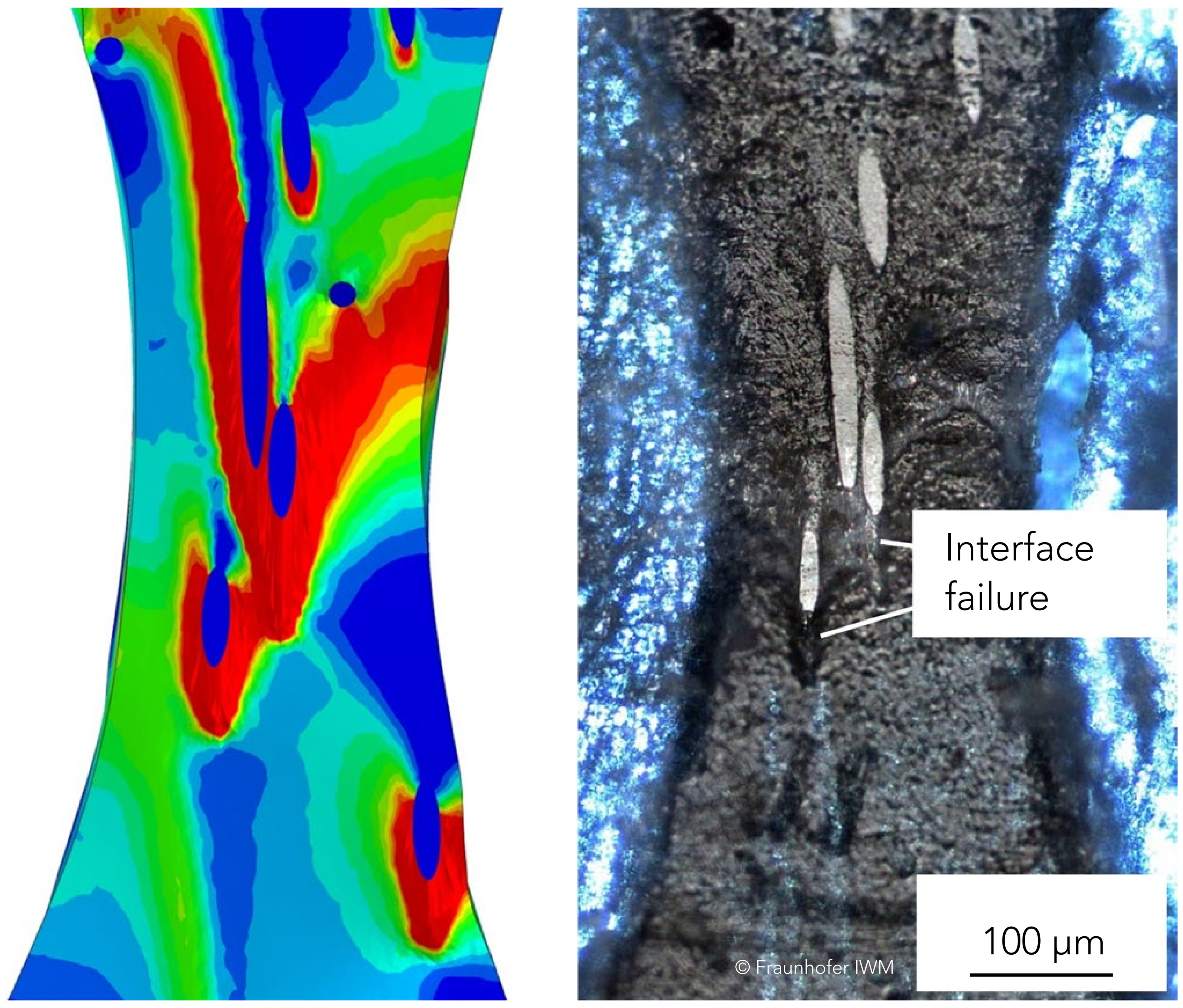


Figure 2: Micromechanical finite element analysis revealing the stress-affected interface areas within the resolved microstructure (interface failure).

It is the goal of this project to improve the properties of reinforced polymers through a well-defined modification of the interface between the fiber and the matrix. We will develop surface functionalizations of the fibers which improve the adhesion to the matrix and thus the mechanical properties of the composites. In addition, the surface functionalization is performed in a way that ensures that both constituents can be separated again during recycling. The surface reactions which are used for this goal are suitable for a wider spectrum of fiber matrix combinations. This will lead to a toolbox for the design of composite materials with properties that are tailored to their respective application. Computer simulations will model the expected microstructures and enable a prediction of the macroscopic properties. This allow for an efficient evaluation of the expected performance of the material, which will especially help us to evaluate the application potential of degradable fibers of natural origin for their use in lightweight materials.

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