SUSTAINABILITY
CENTER FREIBURG

susCOMP: MOLECULAR COMPOSITES FOR SUSTAINABLE LIGHT WEIGHT CONSTRUCTION

Due to their versatility, polymers – and in particular polyolefins – are ideally suited for applications in lightweight construction. Polyolefins are nowadays produced in highly energy- and resource-efficient polymerization processes. These processes avoid solvents or environmentally critical side products, are highly cost- and energy-efficient and therefore result in a small carbon footprint.

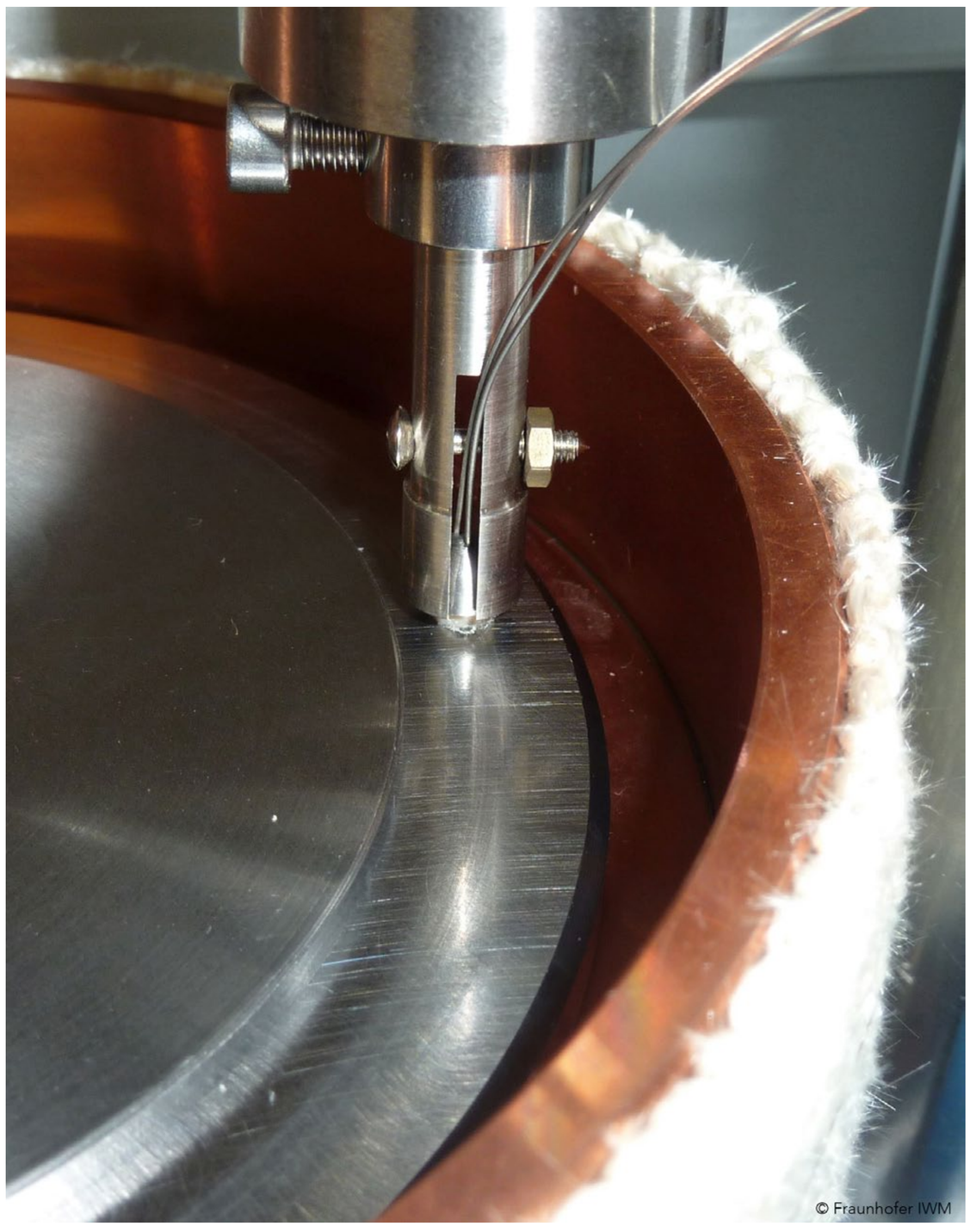

Figure 1: Pin-on-disk tribometer with temperature-controlled frictional partner in order to investigate the temperature dependence of friction and wear of polymers (the polymer specimen is clamped into the pin and equipped with a temperature sensor; the frictional partner is steel).

However, in order to be able to achieve a similar mechanical performance as metallic components, polymers need to be mechanically reinforced by particles or fibers which – in turn – cause problems when the polymer composites are recycled. Molecular composites solve this problem, since matrix and the reinforcing component consist of the same material. A consortium including the FMF, the Fraunhofer IWM and the industrial partner Lyondellbasell will explore novel approaches to synthesize and characterize recyclable »all-polyethylene« composites for applications in sustainable light weight construction. The ethylene polymerization with highly active multi-center catalysts is employed as energy- and eco-efficient key technology to synthesize HDPE/UHMWPE reactor blends.

Nano-crystalline polyethylene reactor blends and additives can significantly contribute to the development of polymers with improved mechanical performance and wear resistance, lower losses and the design of novel adaptive self-reinforcing materials. The properties of the molecular composites will be investigated with a combination of experiments and simulations. The characterization of the deformation behavior, failure mechanisms, friction and wear behavior and the simulation of the mechanical behavior with suitable material models will significantly contribute to demonstrate the technological potential of polyolefins and to introduce them as versatile materials in sustainable light weight constructions.

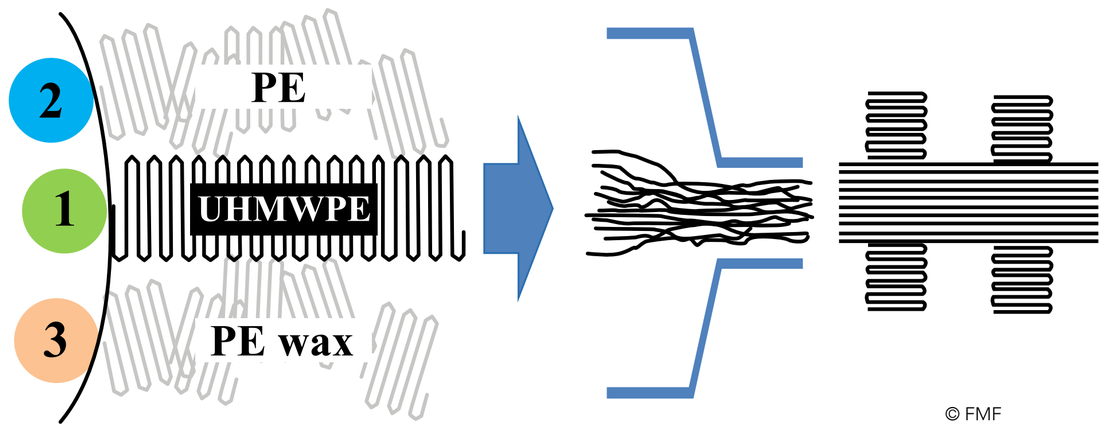

Figure 2: Novel three-center-catalysts generate nano-phase-separated reactor blends. During injection molding of these blends, high strength fibers of ultra-high molecular weight polyethylene (UHMWPE) are formed.

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