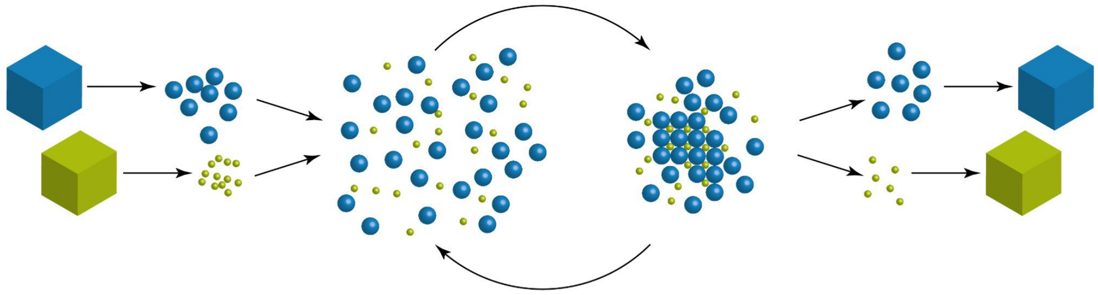
PHYSIKALISCHES KOLLOQUIUM

AM 27. NOVEMBER 2023 UM 17 UHR C.T.

IM GROßEN HÖRSAAL



SOLUBILITY, REVERSIBILITY, AND RECYCLING: DESIGNING CIRCULAR MATERIALS VIA INTERFACES

TOBIAS KRAUS

INM SAARBRÜCKEN

Today's products contain combinations of materials in features with sizes from a few nanometers to many centimeters. This allows industry to efficiently integrate multiple functionalities economically and lightweight in small volumes. Establishing a circular economy requires to identify the different components and separate them for re-use or recycling at the end of product lifetime. This talk will focus on concepts for a destruction-free separation of components that is enabled through reversible interfaces.
Reversible interfaces provide functional connections that can be released with a stimulus, for example when components must be separated at the end of product lifetime. I will first discuss fundamental results on the redispersion of agglomerated particles at different length scales. Particle de-agglomeration in water and non-polar organic solvents is introduced. I will discuss how analytics based on Small-Angle X-Ray Scattering and Ultracentrifugation can quantify the degree of reversibility of agglomeration. Solubility and dispersibility will be discussed as related phenomena, and the role of molecular layers at the interfaces and their structure is introduced.
Reversibility at the nanometer scale is then discussed for the case of printed electronics. Inks based on hybrid particles with metal cores and ultrathin layers of conductive polymers were developed as sinter-free, inkjet-printable conductors. The conductive interfaces between the individual particles form spontaneously upon drying. I will show that the particles can be re-dispersed and recovered to create new inks at the end of product lifetime using the example of a single-use electrode printed on cardboard.
Sintered microparticles are commonly used to create screen-printed metal structures, for example in electrical heaters or flex-connectors. I will discuss how sintering can be tuned such that the metallic bridges between the particles remain small but provide good electrical conductivity. Screen-printed electrical leads are formed from metal particles with different nanoscale structure, sintered at different temperature, and electrically characterized. Their separation and the recovery of the metal powders is discussed.
Lithium-ion batteries contain complex combinations of metal current collectors, active particles in the micro- to millimeter range, and fractal carbon additives. Their electrodes are held together by polymer matrices. Given the considerable growth in battery production globally, I will discuss options and strategies for a more reversible design of such materials and the complex implications on battery performance.
Finally, I will address products where millimeter-scale components are embedded inside polymer parts. In-mold electronics, for example, enables the functional integration of buttons, LEDs, and other electronics directly into polymer cases. I will introduce cases where dissolvable polymer interlayers can be used to release them at the end of lifetime.

AKTUELLE INFORMATIONEN FINDEN SIE HIER: [WWW.PHYSIK.UNI-FREIBURG.DE](http://www.physik.uni-freiburg.de)

universität freiburg