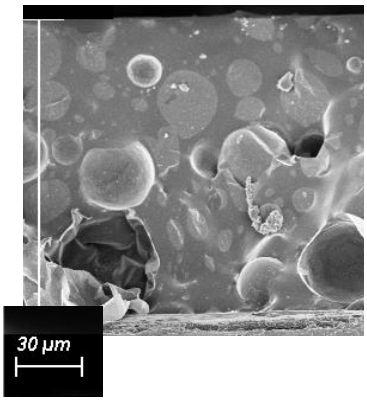
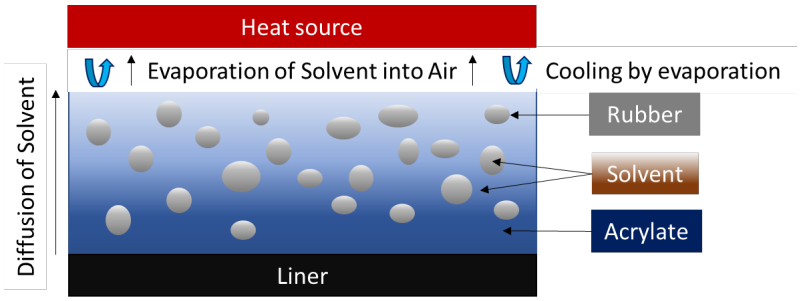
MiMM day 2021 - Modelling solvent borne adhesives



SEM image of a side view of the final microstructural configuration of an adhesive containing two main phases and micro spheres.

Pressure sensitive adhesive can be produced using several different methods. A common method is solving the recipe ingredients, e.g. acrylate and rubber as well as resins into a solvent mixture, e.g. consisting of non-polar and polar solvents. The liquid solvent mixture evaporates under the influence of temperature, and a mixture of the non-volatile substances remains. While being in solution at first, domains are forming during the drying process - a phase separation takes place into an acrylate phase (prominent phase) and a rubber phase (secondary phase). Although in other cases a certain initial phase separation is already in place beforehand. The added resins itself is solved in both phases but migrates within time between both depending of its final solubility. After drying and almost complete evaporation of the solvent the adhesive's microstructure is freezed, and only slower migration processes of the resins may still take place.

The suspects for the causes of the final distribution of the phases and their morphology are manifold: Gravity and density differences of the phases? Buoyancy forces? Solubility of the phase within the different kind of the evaporating solvents? Interaction with the resin distribution? Diffusion barrier building?



Analyzing the processes and connecting them to mathematics, the following underlying mathematical modelling approaches meet the eye

- Diffusion and evaporation of solvent
- Heat transfer, and evaporative cooling
- Phase separation
- Gravity and buoyancy forces
- Flow of the phases and temperature dependent viscosities of the phases
- Migration between phases, and blooming onto the surface
- Mechanical deformation due to shrinkage

And maybe you will find even more! The stepwise separation and analysis of the effects within the complex system may be the point of departure.

The tesa SE team will be happy to discuss this challenging modelling task with you!