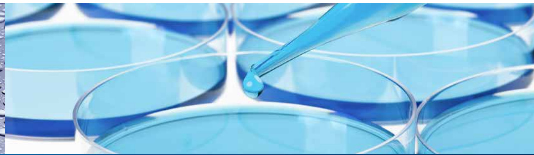
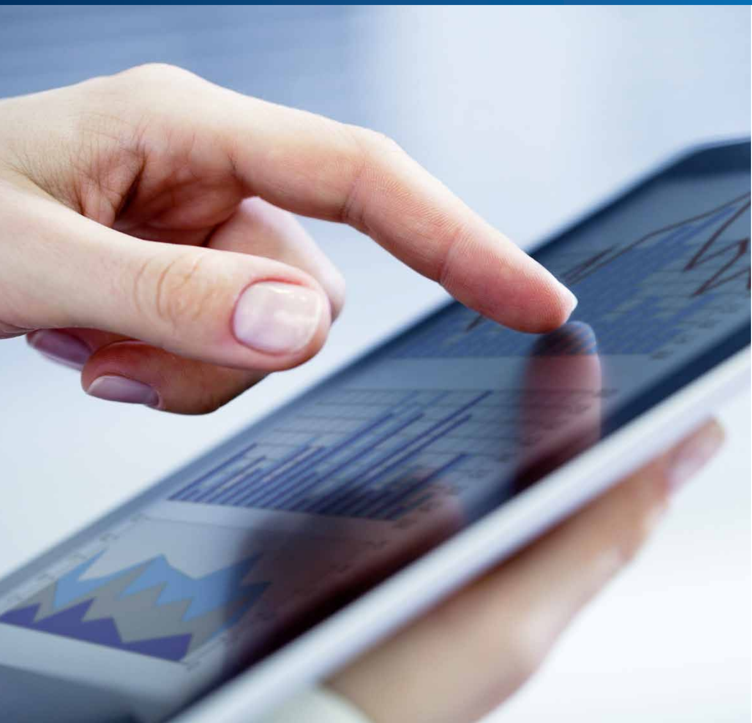
ADHESION ON GLASS







SURFACE ANALYSES FOR OPTIMAL BONDING AND COATING

KRÜSS
Advancing your Surface Science

STABLE GLASS COATINGS AND BONDING WITH TARGETED ANALYSES

- **Glass adhesion**
- **Hydrophobic coating (e.g. auto glass, eyeglass lenses, shower screens)**
- **Manufacture of laminated glass**
- **Nonstick and self-cleaning as well as decorative coatings**

In large-scale industry, glass surfaces are adhered to other materials or coated for a variety of purposes: for safety, easier cleaning or for decoration. In doing so, glass surfaces undergo a series of sensitive steps which are intended to ensure the strength of an adhesive or coating. Interfacial chemistry analyses contribute to the success of the process control and quality assurance.

Bonding or coating of glass require good wetting

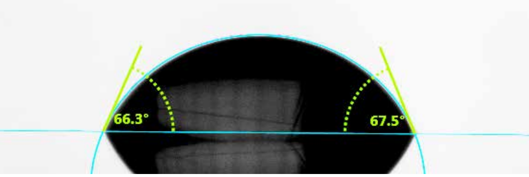
Glass bonding is performed on a large scale in automobile manufacturing, for example. In this process, an adhesion promoter is first applied to the area to be adhered; the molecules of the adhesion promoter bind chemically to the glass. In the second step, the adhesive is applied which in turn forms chemical bonds with reactive molecular groups of the adhesion promoter. These bonds provide the required stability. Similar multi-step processes also take place in the case of many film coatings, for instance during the manufacture of laminated glass.

During application of the liquid adhesion promoter, adhesive or coating material to the surface, good wetting and initial adhesion are important. Only in the case of good wetting will there be a sufficient number of contacts between the respective molecules at the interface between the solid material and the liquid in order to form the desired chemical bonds.

Organic deposits reduce wettability and must be removed

The surface tension (SFT) of a solid, which is generally referred to as surface free energy (SFE), is crucial for the wettability of the material. Mineral glass inherently has a high SFE and it can therefore be generally easily wetted. However, organic impurities, for example due to fats, decrease the SFE and significantly reduce wettability. Therefore thorough cleaning is necessary prior to any contact with an adhesion promoter, adhesive or coating material.

After the cleaning, surface-active substances (surfactants) of the agents used often need to be removed. These do not worsen wettability; however, they form an adsorbed layer and block reactive groups for the subsequent processing step.



The contact angle measures wettability and makes impurities visible

On an easily wettable glass surface, liquids form flat drop shapes, whereas on surfaces which are difficult to wet, for example areas that have been insufficiently cleaned, round drops form. An objective measure for the drop shape is the contact angle which therefore directly reflects the wettability of a glass surface. For this reason, contact angle measurements are especially suitable for checking cleaning steps. In addition, measurements of the contact angle at various positions distributed over the surface give a clear picture of the homogeneity of the surface after cleaning.

Undesired surfactant residues can be detected using the changes in the contact angle with time. In this process, the surfactant molecules originating from the surface of the glass adsorb on the drop surface, reduce the surface tension (SFT) and thus bring about a gradual change in the wetting.

Measurements enable adhesion to be predicted

In the case of chemically binding adhesives and coatings, the initial adhesion has an effect on the final strength. Adhesion is even more important for coatings which do not adhere through chemical bonds but instead purely physically through interfacial interactions. This includes, for example, colored film coatings on glass.

Adhesion at the interface depends on the SFE of the solid and the SFT of the liquid coating material. The SFE and SFT develop in each case through polar and disperse interactions which are present in different proportions for each substance. The adhesion is the greater the more similar the liquid and solid phase are with regard to the polar and disperse interactive components.

In order to determine the SFE and its polar and disperse components, contact angles are measured using multiple liquids for which the interactive components of the surface tension are known. Water, which is highly polar, and diiodomethane, which is a purely disperse liquid, are two frequently used test substances. With additional methods, for example optical measurements on pendant drops, the SFT can be determined with its polar and disperse components. After such separate analyses of the solid and the coating liquid, a calculated value for the adhesion and thus helpful information for optimizing the components involved for a coating is available.

MEASUREMENT METHODS

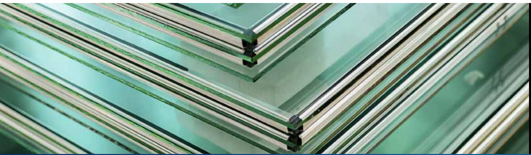
There are a number of analytical methods that characterize glass surfaces and, in so doing, provide important information for optimizing glass coatings and adhesives:

- Taking optical measurements of the contact angle (drop shape analysis), static and dynamic
- Taking mechanical measurements of the contact angle using a tensiometer
- Determining surface free energy and its polar and disperse components
- Measuring surface tension of liquids
- Calculating adhesion and interfacial tension
- Measuring the roll-off angle of drops on hydrophobic surfaces

KNOW-HOW FOR YOUR APPLICATION

If you would like more detailed information about your application, just get in touch with us. Our scientifically trained customer representatives have excellent knowledge of interfacial chemistry and process technology and share their expertise – comprehensively and competently.

We would also be happy to assist you with professional contract analyses from our laboratories. In addition, we provide scientific application reports on various topics which cover specific issues in research, development and quality assurance. With offers like these, we pass on a great deal of know-how for your application.



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