



1 Structure models of two different UV-curing clearcoats with non-crosslinked double bonds.

SIMULATION-BASED DEVELOPMENT OF FUNCTIONAL PROTECTIVE COATINGS

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For developers of corrosion protection and paint or lacquer systems, polymers containing additives or fillers allow the formulation of customized functional protective coatings for a wide variety of applications, for example for lightweight structures or as an adhesive respectively coating for metal surfaces. This is particularly relevant because the REACH regulation generally considers these materials to be fairly harmless.

Shorter development times and minimized risk

The Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM offers simulation-based methods for the development of functional protective coatings. With these methods, a pre-selection and evaluation of formulations can be carried out which lead to considerably shorter development times and minimized risk. By prediction of structure-effect relationships, the Fraunhofer IFAM supports additive

and paint formulation specialists as well as coating specialists in industry in their daily work.

Strategy

The experts of Adhesion and Interface Research at the Fraunhofer IFAM use the developed material simulation methods to predict the structure formation in the polymer coatings to be investigated. Key parameters for materials development are thereby identified in collaboration with the specialists of the project partners.

Formulations can be customized in that way that after curing a maximum degree of crosslinking or a dense layer of non-crosslinked polymer molecules on the substrate surface can be obtained. Surface analysis and application-related coating tests allow verification within a short time and fine adjustments with the simulation-based derived development trends.

UV-curing clearcoat systems

A simulation method developed at the Fraunhofer IFAM allows to predict the mechanical properties of new UV-curing clearcoat systems based solely on the formulation and is therefore allowing to compare different formulations at an early stage of the development. This leads to significantly shorter development times for new coatings. In addition, conclusions can be drawn about the chemical resistance, volume shrinkage, and elasticity.

Polymeric corrosion inhibitors

By the application of simulation methods, the Fraunhofer IFAM succeeded in developing polymeric corrosion inhibitors. These provide effective corrosion protection either as a thin layer of just a few hundredths of a micron thickness or in the form of polymeric additives for coatings. It has been demonstrated that various metals and alloys – including aluminum and copper alloys, steel, as well as galvanized steel – can be protected against corrosion in this way. Furthermore, it is possible to incorporate the inhibitors into different paint and laquer systems, for example water-based and solvent-based epoxide systems, oxidatively drying alkyd resin coatings, and alkyd-melamine baking varnishes.

Protective coating modeling to aid development work – Expertise

Future-oriented simulation-based material research is becoming an ever more integral aspect of developing innovative coatings. The experts of Adhesion and Interface Research at the Fraunhofer IFAM have many years of experience in this area. Since 2012 commercial products have been available on the market in multi-tons in whose development simulation-based material research was significantly involved.

Portfolio of the Fraunhofer IFAM

- Development of concepts for functional protective coatings for scratch protection, corrosion protection, as well as protection against chemicals and UV radiation
 - Development of coatings and adhesives for specific applications
 - Pre-screening and optimization of paints/lacquers, adhesives, and functional coatings
 - Definition of specifications for customized coating processes
 - Surface modification of technical substrates (cleaning, activation, functionalization, coating)
 - Pre-selection and evaluation of formulations
 - Calculation of coating properties based on formulations
 - Determination of structure-effect relationships
 - Development of special coating application techniques
 - Quality assurance for coating processes
- ➔ Shortening of development times and risk minimization