



Fraunhofer ISC

FRAUNHOFER INSTITUTE FOR SILICATE RESEARCH ISC



1-2 Magnifying lens with scratch resistant PMMA coating
© Eschenbach

ORMOCER® COATINGS WITH HIGH SCRATCH AND ABRASION RESISTANCE

Fraunhofer-Institut für Silicate Research ISC

Neunerplatz 2
97082 Würzburg
Germany

Contact
Competence Unit Materials Chemistry
Hybrid Coatings and Coating
Technology

Dr. Klaus Rose
Phone +49 931 4100-626
klaus.rose@isc.fraunhofer.de

www.isc.fraunhofer.de

Initial situation

Optical lenses as well as architectural and automotive glazings have been the domain of glass for a very long time. But for many applications, the brittleness and high weight of glass is prohibitive, leading to an increased use of plastics. Several organic polymers exhibit high transparency and are comparable to glass in this respect. Furthermore, engineering plastics have been increasingly applied in other fields, like touch panels or displays for industrial machinery or instruments as well as for plastic furniture.

Polymers are light-weight materials, show high impact strength and can be processed into very precisely defined shapes via injection molding or extrusion techniques. A decisive disadvantage is, however, their poor surface hardness. Even after short operation

times, scratches often reduce their optical quality and durability. Similarly, for numerous applications soft metals and functional glasses also need an additional surface protection.

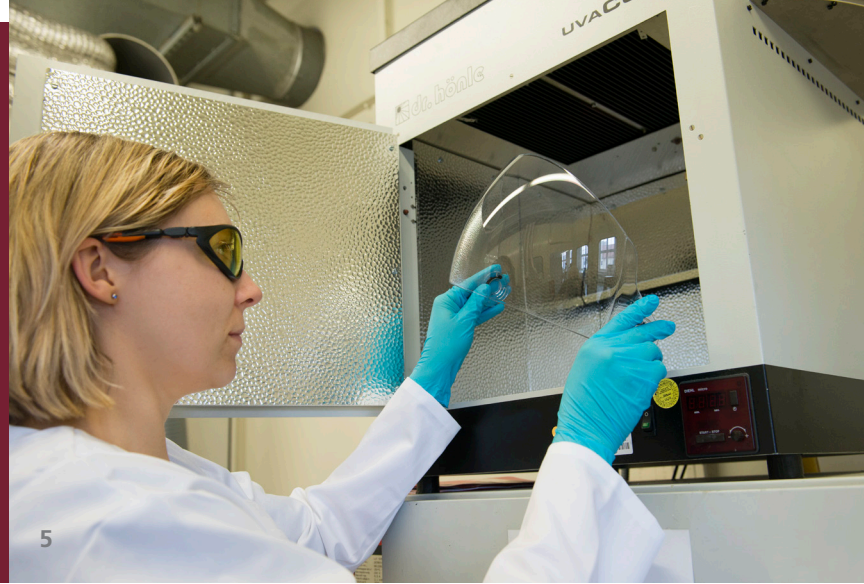
Therefore, there is a strong need for transparent, scratch and abrasion resistant coating systems with good adhesion to different polymeric substrates. Their application should be possible by inexpensive, conventional paint technologies.

Solution

By using ORMOCER®s (inorganic-organic hybrid polymers), scratch resistant coating systems for different substrate materials were successfully developed. The coating materials are synthesized via the sol-gel-process. Conventional coating techniques, like dip-, spin-, spray-coating or casting are used for application.



4



5

An organic polymerization reaction is used for curing the films, initiated either by thermal treatment between 80 °C and 180 °C or by UV exposure at ambient temperature. Electron beam and plasma treatment have been also successfully used to receive highly crosslinked scratch resistant films.

Properties

- good scratch resistance even with layer thicknesses of a few µm
- optical properties: the coatings are colorless and highly transparent
- colorants, pigments and fillers may be added
- scratch resistance can be combined with other functions such as anti-soiling, easy-to-clean, antistatic

Fields of application

- scratch resistant coatings of plastics
- protective coatings for metals against chemical or mechanical influences

Table 1
Abrasion resistance of different ORMOCER® coatings

substrate	layer thickness [µm]	% haze *) coated	curing method
polymers			
CR-39	10	1.4	thermally
PET	10	1.5	thermally
PMMA	10	1.4	UV
	10	1.5	UV
PC	14	1.6	thermally
	10	1.5	UV
PS	10	1.4	UV
glass			
metallized glass	15	2.1	thermally
metal			
brass	10	1.0	thermally

4 Production of the coated magnifying lenses at project partner Eschenbach Optik GmbH © Eschenbach

5 UV curing © Fraunhofer ISC

*) taber-abraser-test: 100 revolutions, 500 g load, CS 10 F abrasive wheels