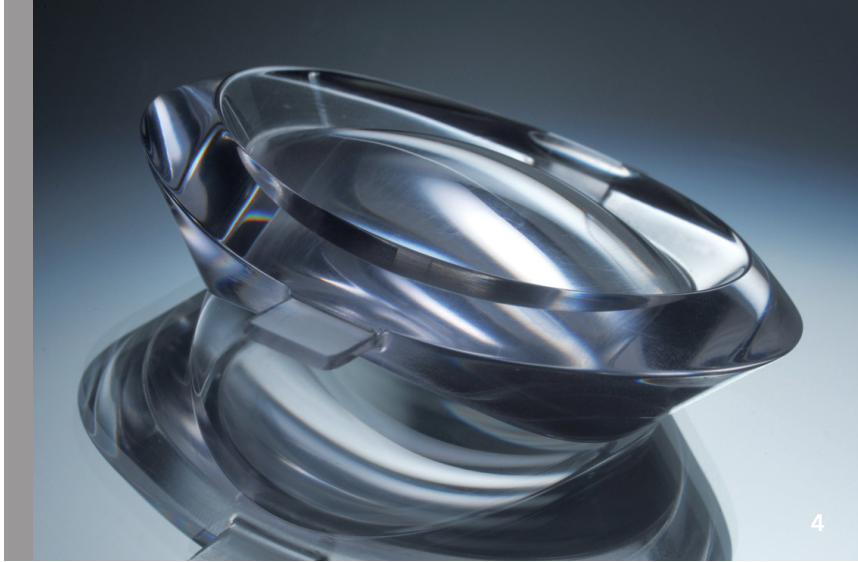


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DEVELOPMENT OF POLYMER FREEFORM OPTICS FOR AUTOMOTIVE LIGHTING

Task

Compared with glass optics, optics made out of polymers are lighter and can be mass produced cost-effectively using injection molding. This in turn provides much greater flexibility in designing the optical surfaces. Limitations associated with the injection molding process need to be considered when manufacturing polymer optics. The aim is to minimize structural dimensions and weight as well as minimizing the power input of automotive lighting in conjunction with efficient LED light sources.

Method

Conventional optics for automotive lighting, which are used for applications such as dipped headlights and fog lights, tend to use a shutter imaged onto the road, thus ensuring good illumination without dazzling other road users. While this does provide a sharply defined light-dark cutoff, it nonetheless also limits the efficiency of the optics, since the shutter shades part of the emitted light. Freeform optics allow the angular distribution of light emitted by LEDs to be transformed into a required target distribution without shading, thus maximizing the efficiency of the configured optics. Using a combination of two freeform optics at the entry and exit surfaces allows the component geometry to be optimized for injection molding process requirements.

Result

An initial demonstrator for a fog light with two freeform surfaces was optimized and successfully qualified by project partner HELLA in relation to legal requirements for luminance distribution. For a second demonstrator, manufactured as an injection-molded component, daytime running lights were integrated as a further lighting function alongside the fog light, achieving an efficiency of 60 percent.

Applications

The algorithms developed for the simultaneous optimization of multiple freeform optics can be used in all areas of lighting technology where an application-tailored target distribution is required with a given input distribution, e.g. street lighting as well as interior and exterior architecture.

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3 Ray-tracing model of the freeform fog light optics.

4 Implemented prototype of the freeform fog light optics.