RADAR GLASS

Design and manufacturing of transparent, functional coatings for manipulating radar waves

In addition to other sensors, radar systems in particular are increasingly being used in modern driver assistance systems to increase comfort and road safety. They have the advantage that they function reliably over long distances even under harsh conditions. However, the installation of additional sensors is strongly limited by the available space.

The "RadarGlass" project addresses several current challenges by aiming to integrate a radar sensor into a car's headlamp. The radar system is less disturbed by the cover and in addition, the position offers the possibility of looking both forward and to the side. The heat generated by the light source keeps the radar sensor free of snow, ice and rain.

In this project, a novel coating is being developed that functions as an antenna system for automotive radar. The layer is almost transparent in the visible range so that the function of the headlamp is not impaired. High-precision laser ablation produces fine resonant structures that allow the radar waves to be directed and focused.

Through this project many possibilities of utilization will be opened up in the automotive and automotive supply industry, whereby a variety of impulses can be expected from the current development trend of autonomous vehicles. In addition to licensing agreements, further collaborative projects with industry are being sought with a view to implementation in series production.

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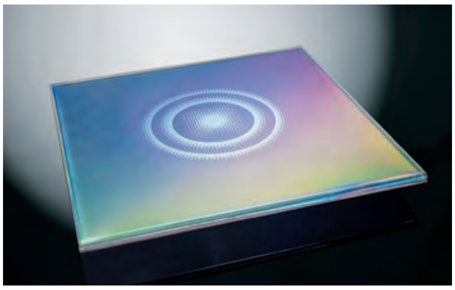
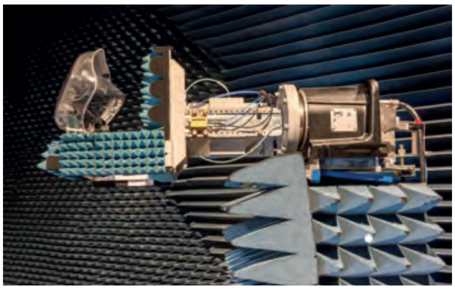
The joint-project RadarGlass is creating a patented technology for the discreet integration of radar sensors into headlights.

A patent on the effective arrangement of the antenna (radar module) within a headlamp and its method of fabrication has been filed. The headlamp structure offers several advantages compared to the conventional placement on the chassis: the bigger volume of the headlamp can integrate not only the radar module, but also other sensors which are based on infra-red cameras, Lidar, and ultrasonic technologies. In addition, the headlamp cover acts as a radome and has lower losses compared to bumper materials, especially when painted with metallic paints. Due to the heat radiation of the light source, it provides protection from snow and rain.



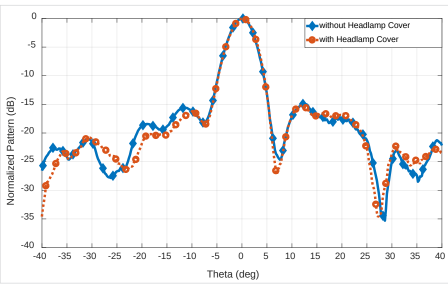
The textured electrically conductive film coating is able to steer and shape radar signals, while remaining transparent for visible light.

To be able to integrate a radar sensor into a front headlamp, a special transparent coating was developed that withstands the harsh environmental conditions in an automobile and is able to manipulate radar waves due to its electrical conductivity. A process for applying and structuring has been developed so that complex antenna patterns can be generated on transparent substrates. Using laser ablation, fine elements can be produced with high precision on surfaces of any shape. These structures allow the shaping and guidance of radar waves by phase corrections.



The performance of the radar antenna and the influence of the headlight cover is precisely measured with sophisticated equipment in the range of 76–77 GHz.

To check the suitability and performance of the radar reflector, measurements were carried out at the compact range facility of the Institute of High Frequency Technology (IHF) RWTH Aachen University. In a sophisticated setup the beam pattern in horizontal and vertical direction as well as the antenna gain in the frequency range of 72–82GHz was measured. It could be shown that the main lobe is bundled in an angle of 5° and has a gain of >21 dBi. In addition, the influence of the headlight cover on the radar signal was determined.



Measurement results of the azimuthal radiation pattern for the radar reflector with and without cover glass only shows minimal influence.

In order to prove the functionality of the fully integrated module, a measurement of the radiation pattern with and without the headlight cover is conducted. It could be shown, that the cover main lobe is not affected, while the side lobes slightly change. The stability of the beam pattern was validated by changing the relative position of the cover, which did not lead to any change in the beam distribution. In addition, the combination of multi-patch antennas with the reflector was tested and showed an almost constant performance for large angular ranges, confirming its suitability for integration into radar modules.