AR NEWS

32nd issue, April 2016, Allresist GmbH

Content:

Welcome to the 32nd issue of the AR NEWS. We would like to inform you again about the development of the company and its research projects.

1. Allresist in the 24th year: A steady upswing with innovations

The innovations of the last two years (marketing of CSAR 62 and Electra 92 and the extension to increase our production capacity) have contributed significantly to the best annual result since Allresist was founded. To maintain this upswing also in the future, further new product developments and research projects as well as an expansion and modernisation of our laboratories are on the way. Our laboratory area will be completely re-equipped and modernised in two weeks. This modernisation will not only extend the capacities for product development and quality control, but also improve labour safety and considerably enhance the comfort factor for our employees.

One focus of our most recent R&D activities is the further development of the "flagship products" CSAR 62 and Electra 92. CSAR 62 has already been successfully used for the etching of 50 nm dots with diluted hydrofluoric acid. Another experiment showed that this resist can also be exposed in the EUV. We are currently working on the development of thicker layers and a possible use of this resist in multi-layer coatings (e.g. for T-gates). Novel applications were also discovered for Electra 92. This resist can be used in scanning electron microscopy or for the manufacture of actuator electrodes. And, last not least, customised modifications for all available e-beam resists are developed.

The Eurostars project PPA-Litho and the project smart³ are progressing according to plan; interim results will be reported on in the next AR NEWS. In September 2016, the large Agenda 2020 project "Polyphotonics - Optical components composed of polymers" with 13 cooperation partners will be added. In this working group, all partners are for the first time able to realise comprehensive solutions for applications of optical components on polymer basis which have so far not been availabe in this form worldwide. Main objective is the development of new innovative materials, procedures, and photonic components offering a large variety of possible applications.

Some of these materials can also be used for applications in microelectronics and micro-systems technology.

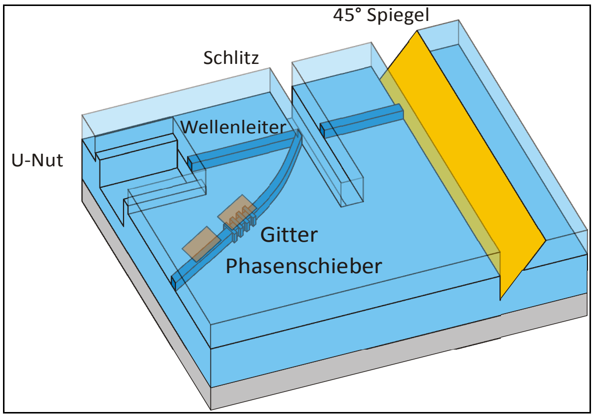

Fig. 1 Photonic component produced with different resist technologies (see item 5)

2. Electra 92 as conductive layer for SEM-images

The further imrpovement of the Electra-polymer production (polyaniline derivatives) at Allresist resulted in an increase of the batch quantity. It is thus now ensured that the meanwhile considerably increasing demand for this conductive resist worldwide can be satisfied without any delivery problems on our part. We furthermore improved the purification procedure after synthesis – with promising results, since we measured a tenfold increase in conductivity of these high-purity polymers. The improved conductivity definitely extends the application range of Electra 92.

Assessed was also the application of Electra 92 in scanning electron microscopy (SEM) on insulating substrates as alternative to thin, vapor-deposited noble metal layers. If insulating substrates are used, often a fast electrostatic charging of the surface occurs which deflects the incoming electrons and thus massively disturbes a correct imaging. Vapor deposition (sputtering) of precious metals like gold or palladium increases the quality of the imaging process significantly, since the metal layer effectively discharges excess electrons. The use of precious metals is however laborious and expensive.

Recent studies by Mr Hentschel (4th Physical Institute and Research Center SCoPE, University of Stuttgart) demonstrated that the conductive coating Electra 92 represents a good alternative. If this resist is applied onto highly electrically insulating polymers or glass, still a high-quality imaging of nanostructures with SEM is possible:

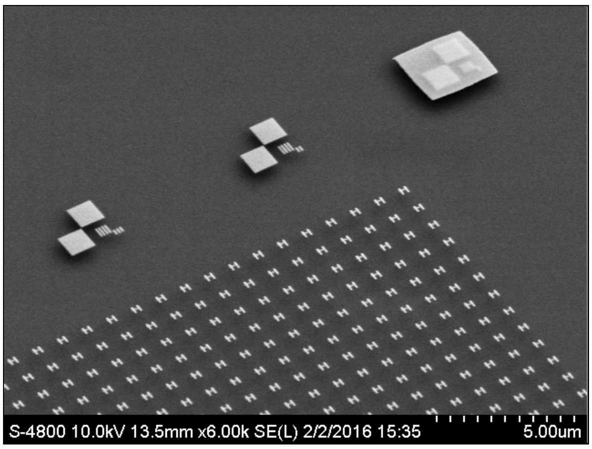

Fig. 2 Strongly isolating polymer structures (coated with Electra 92, AR-PC 5090.02) in SEM

After SEM analysis, the conductive coating can be completely removed again with water.

3. Poly(phthalaldehyde) (PPA) as e-beam resist

Within the scope of the Eurostars project PPA-Litho, APPs are also investigated with respect to their suitability as positive-working e-beam resist. First results of the company Raith demonstrated that a patterning with electron beams is possible. PPA-resist solutions are thinly applied by spin coating (80 nm) and tempered. Structures are generated directly during the writing with an electron beam; no development is required. In previous first tests however, structures were not fully exposed and a residual layer thickness remained. The residual layer thickness of the structures can be reduced by post-curing at 120 °C. An addition of acid generators intensifies this effect even more. These results correlate with results obtained for photo-lithography; in this case also a residual layer remains after exposure and partial direct development. The layer increases again with an increasing exposure dose. The causes and possible mechanisms are currently discussed intensively in the project group, and there is still a lot of interesting research work to be done in the future. We will be pleased to involve all interested external parties in this discussion.

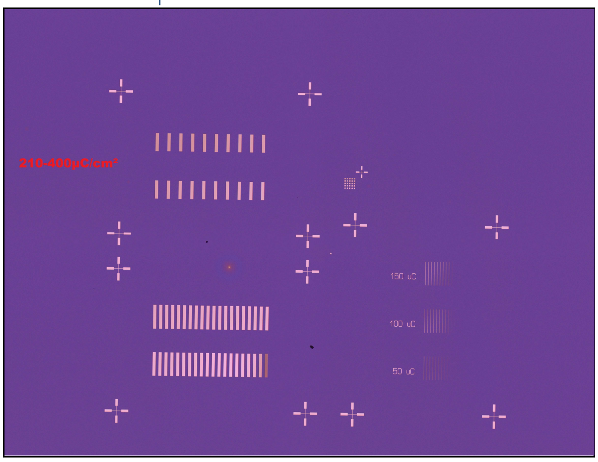

Fig. 3 Test structures of PPA resists after direct patterning via e-beam lithography

4. Conductive polymer electrodes for stack actuators – smart³

Stack actuators are components that shrink or stretch when subjected to electrical current. Dielectric elastomer actuators (DEA) consist in the simplest case of an elastomeric film and stretchable electrodes bonded to it. The electrodes cause a deformation of the film and thus an actoric when voltage is applied (see Figure 4).

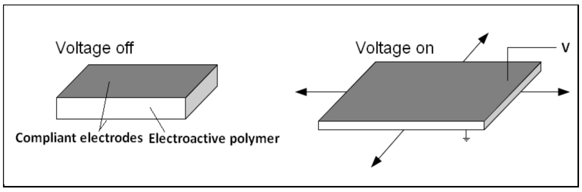

Fig. 4 Stretching of the film when voltage is applied

This process can be compared with the contraction of a human muscle.

Fig. 5 Comparing muscle and "actor arm"

Main focus of the project in terms of technical developments is the processing of layers as thinly as possible, the deposition of suitable structured electrodes, and the processing of stack actuators which are of particular importance for technical applications.

Within the scope of the smart[3] project, Allresist has already investigated various materials and procedures for the manufacture of electrodes on the respective elastomers. Materials suitable for a use as electrodes must be sufficiently conductive, should adhere well to the elastomer to be deformed, and in addition be long-term stable – a real challenge!

We now found a promising approach. In a first step, Electra 92 was applied in various mixtures with other substances to the elastomers, but the adhesion was in no case satisfactory. By adding ionogels (which are conductive polymers themselves and whose properties can be adjusted by variable mixing ratios), a successful coating could be achieved. These layers in addition have a good conductivity. Until the end of the project in July 2016, properties such as moldability and long-term stability will be investigated.

We intend to design a patternable conductive photo- or e-beam resist composed of this material also beyond the scope of the project. If one of our well-disposed readers should be interested in the simple manufacture of conductive structures or in the electrode material itself, please let us know.

5. Polyphotonics – new resists for optical components and applications in microelectronics

Optical polymer components are advantageous because they are significantly smaller than comparable other components. They are preferably used in large data centres which are literally "bursting at the seams" already.

Fig. 6 Spatially overstrained data centre

Allresist will develop waveguide materials and special resists in this project. Figure 7 exemplarily shows an optical components is with all resist applications:

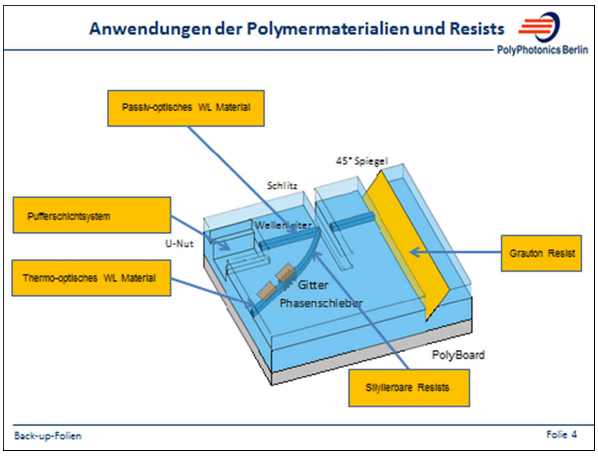

Fig. 7 Component with points of use of resists

The right side of figure 8 shows one of the produced waveguides. The actual waveguide (core) forwarding the optical signals is embedded in another polymer (cladding). Both polymers are chemically very similar, but differ in their refractive index

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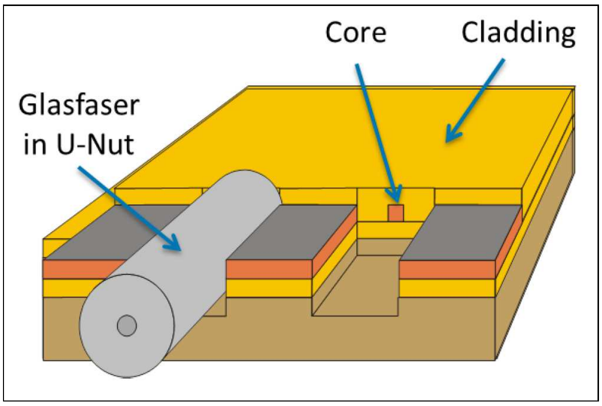

Fig. 8 Waveguide embedded in a component (right) and coupling of a waveguide fiber via a thick buffer layer (left)

Both polymers will be developed by Allresist. Since quite likely in both cases fluorinated polymethacrylates are concerned, may these polymers possibly be also of interest for users of microelectronics. Particularly noteworthy is the low refractive index of less than 1.5.

We currently furthermore design thick buffer layer systems. Polymer layers up to 150 µm are etched via a two-layer system with a photoresist in such a way that U-grooves are generated in the optical component. The glass fibres are then "clicked" into these assembly grooves. This facilitates the connection of the components with the optical fiber network (see Fig. 8, left). This resist could later also be used in microsystems technology.

For the plasma etching of layers, particularly plasma-stable silylated resists are developed. These resists will in the future also be used for applications in other complicated etching processes.

For the production of 45° mirrors serve gray-tone resists which allow a three-dimensional structuring (Fig. 7, far right), and will have a contrast of <1.

The polyphotonic project runs over a term of 3 years; first results will already be available by the end of 2016.

We hope that you found some inspiration and encourage you to send us your specific requests.

You are welcome to visit our stand at the **MNE 2016 in Vienna (19. - 23.9.2016)** and at the **Semicon Europe 2016 in Grenoble (25. - 27.10.2016)**.

The next issue of AR NEWS will again be presented in October 2016.
Until then, we wish you and us a lot of success.

Strausberg, 27.04.2016
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im Team der Allresist