AR NEWS

48th issues, October 2023, Allresist GmbH

Content:

Welcome to the 48th issue of our AR NEWS. Unfortunately, we currently live in crisis-ridden times. The never-ending war in Ukraine, weather disasters, inflation, as well as ever new migration waves deeply worry many people. Quite obviously, politics (including German politics) seems unable to effectively address the major problems regarding climate protection, hunger, poverty, migration, and many more other troubling issues. Especially important is now that we all do our best together, even on a "small scale", to preserve the earth and its living beings. Allresist has been actively engaged in these efforts for years, for example with photovoltaic/green roof installations, reduced carbon footprint, tree planting campaigns, and numerous donations for people in need and during environmental disasters (→ 47th AR NEWS).

As in every April and October, we would like to keep you informed about the progress of our company and its research projects.

1. Allresist on the MNE 2023 in Berlin

This year, the MNE took place in Berlin from September 25th to 28th – which is more or less right on our doorstep. As gold sponsor, we again participated with a representative Allresist stand.

Fig. 1 Research & Customer Advisory Team at the Allresist stand. From left to right: M. Schirmer, M. Sendel, H. Biller, and M. Gerngroß

It was a great pleasure for us to see many familiar faces and to exchange ideas with numerous partners and users about technical details of e-beam and photolithography. Some questions and problems were clarified or resolved right away at the stand, while others require further joint discussions and investigations. The interest once again focused on our three crowd pullers CSAR 62, Electra 92, and Medusa 82. Furthermore, we presented initial results of our current development Medusa 84 SiH, a resist comparable to HSQ, but with improved properties. This new resist development attracted great interest from all users of e-beam lithography at the stand (→ item 2), but also our photoresists were in strong demand. For lift-off processes, the bottom resists (AB-BR 5400) in two-layer systems were particularly popular. Many customers were also increasingly inquiring about coloured or fluorescent photo- and e-beam resists (→ item 5).

On September 27, our research associate Harry Biller presented the poster “Tuneable refractive index polymer waveguides for photonic sensor platforms using wavelengths from 400 nm to 1650 nm”. This work was created in cooperation with the Fraunhofer Heinrich-Hertz-Institute, Berlin, as part of the RUBIN project (→ item 3).

2. Medusa 84 SiH – SX AR-N 8400, another alternative to HSQ with better properties

Resist HSQ is used worldwide in electron beam lithography. Despite its undeniably good properties, its shelf life is however limited. After many customers reported that the supply of HSQ might become significantly more difficult because production is to be discontinued in the near future, we decided to develop a further (third) alternative, analogous to the HSQ, with greater stability and high transparency at the same time. Our new development consists (similar to HSQ) of inorganic silanes (SiH) and is called Medusa 84 SiH (SX AR-N 8400).

The desired high level of transparency is important for a larger group of customers who intend to use such resists for optical applications. These could, for example, be structures produced with electron beam lithography such as the diffractive optical element (DOE) shown in Fig. 2, or unstructured functional layers in the optical industry.

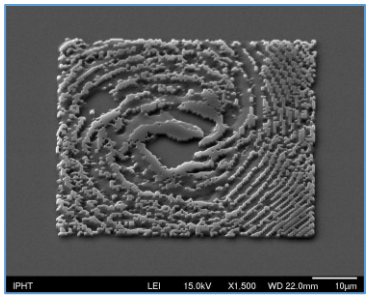

Fig. 2 DOE produced with Medusa 82; @ U. Hübner, P. Voigt, Leibniz Institute of Photonic Technology, Jena

The new polymer was developed in cooperation with our partners at the Institute for Thin Film and Microsensoric Technologies (IDM). Samples of this new resist which were stored for more than eight months maintained the same high quality. Various partners tested initial samples (→ Fig. 3) and confirmed the excellent properties. In our opinion, Medusa 82 SiH thus perfectly meets the same qualities and application features like the original HSQ, but with improved shelf life ☺.

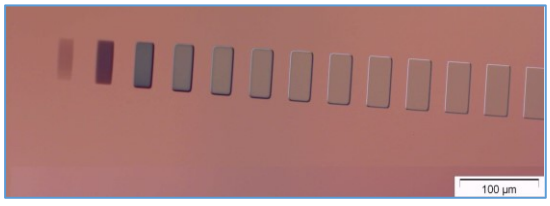

Fig. 3 Dose scale of Medusa 84 SiH, dose 950 µC/cm², 30 kV, developer AR 300-44

The product launch for Medusa 84 SiH will begin in January 2024, but 30 ml test samples are already available from November 2023 to interested customers. We thus now offer three Allresist alternatives to HSQ with different application properties (→ Tab. 1). The two previously developed variants Medusa 82 and Medusa 82 UV are briefly described here for comparison:

Medusa 82 – SX AR-N 8200

In response to numerous customer requests, Allresist developed its first alternative to HSQ in 2020. The product was named Medusa 82 (SX AR-N 8200), has a significantly longer shelf life of at least six months compared to the HSQ, is more process-stable, and easier to remove. If Medusa 82 layers are tempered after irradiation (Post Exposure Bake, PEB) up to 170 °C, the sensitivity can be increased by a factor of 20.

Medusa 82 UV – SX AR-N 8250

For customers interested in higher sensitivity without an additional annealing step (PEP), Allresist developed a second alternative in 2021 called Medusa 82 UV (SX AR-N 8250). This resist contains a photoacid generator (PAG) which accelerates cross-linking in the irradiated structures at a 20-fold lower dose. All other advantageous properties are identical to Medusa 82.

However, both product variants Medusa 82 and 82 UV have a lower optical transparency than HSQ which is due to their partially organic chemistry.

We here present a brief summary of the important application properties of the three Medusa variants in comparison with the HSQ:

Please notice:
In 2024, **Medusa 82 UV** will be renamed **Medusa 82 PAG** since this describes the application properties more precisely (the resist cannot be structured in the broadband UV range).

Comparison with HSQ	Shelf life	Sensitivity	Transparency
Medusa 82	higher	higher with PEP	lower
Medusa 82 UV (-> PAG)	higher	higher without PEP	lower
Medusa 84 SiH	higher	identical	identical

Tab. 1 Comparison of the three Medusa products with the HSQ

Further advantages of the three Medusa products are:

- ready to use in several layer thicknesses
- quickly available
- considerably cheaper than the HSQ

3. Rubin project – waveguide materials for the NIR/VIS range (→ 47. AR NEWS)

The goal of the overall project is the fabrication of optical components (waveguides) based on polymer materials. A major challenge for Allresist in this project is to develop waveguide materials that are self-structuring like photoresists. Until now, waveguides have been produced in a complex manner using a two-layer system with photoresists.

Although the project is still in its early stages, we could already present the first practical results at the MNE:

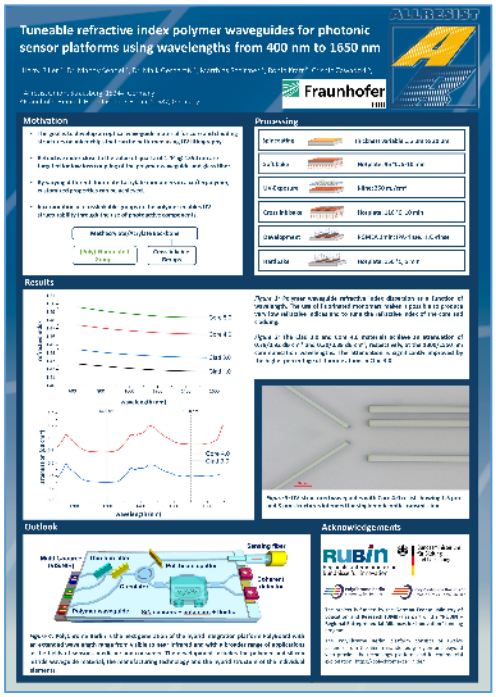

Fig. 4 MNE 2023 poster of Allresist: Waveguide materials

Shown in the middle of the right poster page are 1.5 µm and 3.0 µm wide waveguide structures that were generated according to the process elucidated at the top right. Exposure took place at i-line (365 nm), and AR 300-12 (PGMEA) was used as developer. At the bottom left, the waveguides can be seen as thin lines on the optical platform.

However, a lot of work still needs to be put into the RUBIN project. The optical parameter attenuation and the precise adjustment of the refractive index of the polymers still require detailed qualification.

If you are looking for a solvent-developable photoresist whose polymers have a refractive index of 1.45 or are even involved in the production of waveguides, please feel free to contact us.

4. Successful introduction of the new Electra 92

About a year ago in October 2022 we reported in the 46th AR NEWS about our improved Electra synthesis and the resulting increased quality of the aniline polymers. This made it possible to completely dispense with the addition of isopropanol in the resist solvent; Electra 92 (AR-PC 5092) contains only water as solvent. In addition, new surfactants were detected that result in a significantly improved coating behaviour.

In a concentrated action, samples of Electra 92 (AR-PC 5092) were sent to all Electra customers who had ordered the "old" variants Electra 90 and 91. The feedback of our customers was consistently positive with respect to the properties of the new resist AR-PC 5092.

The long-term tests in our company also produced very good results, and the shelf life of Electra 92 could be increased to 1 ½ years.

Our goal is to largely replace the other Electra variants (Electra 90 and 91) by AR-PC 5092 in the future. It would be very helpful if you could share your experiences concerning this resist with us. Particularly interesting for us is all information with respect to the coating behaviour on non-Allresist resists ☺.

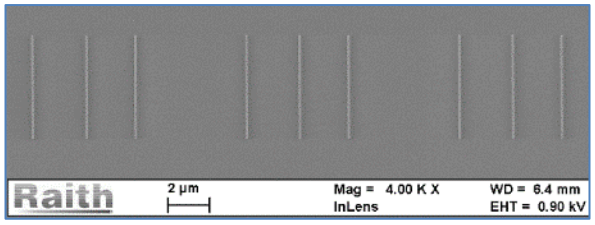

Fig. 5 Electra 92 (AR-PC 5092) coated over CSAR 62 on glass

5. Coloured and fluorescent resists for optical applications

Somewhat surprising to us was the increased demand for coloured resists. In recent years, we have created and offered a few coloured resists, but these products have so far been only sporadically requested.

For photolithography, Atlas 46 (AR-N 4600) was differently coloured, and we were able to apply these different colours onto a substrate in several steps (→ Fig. 6). This can, for example, be used to produce coloured arrays for spectral analyses.

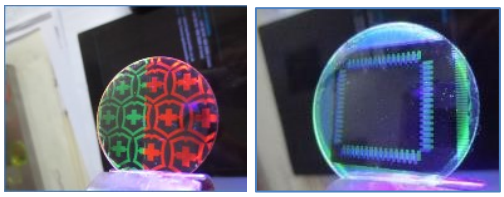

Fig. 6 Glass substrates with coloured AR-N 4600

Atlas 46 resists can also be used in e-beam lithography. Allresist provided the company Precision Optics Gera GmbH (POG) with various coloured Atlas resists which were then applied onto a wafer for demonstration purposes. Five different coloured structures were added one after the other to this glass wafer. Different colours are advantageous for e.g. labelling nanostructures.

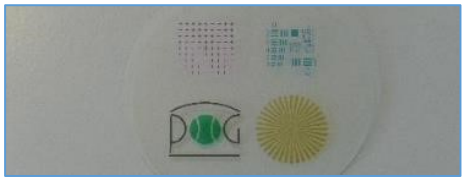

Fig. 7 Demonstration wafers in five different colours

Furthermore, fluorescent dyes were introduced into PMMA e-beam resists of the AR-P 672 series; irradiation and development were performed with standard PMMAs (→ Fig. 8).

If the resulting structures are now excited by UV irradiation, they glow intensely. Such luminous structures can e.g. be used for attractive everyday objects such as household devices or house number lighting, but also for high-quality luxury items (watches, cars, yachts and the like).

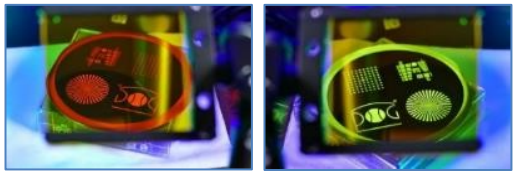

Fig. 8 Fluorescent e-beam structures with SX AR-P 672.08 in red and yellow-green fluorescence

We hope that you found some interesting news or suggestions and look forward to your comments. The next issue of our AR NEWS will again be presented in October 2021.

Until then, we wish you and ourselves every success ☺.

Strausberg, 16.10.2023
Matthias & Brigitte Schirmer in the Allresist Team –
31 years of Allresist ☺