AR NEWS

37th issue, April 2018, Allresist GmbH

Content:

Welcome to the 37th issue of the AR NEWS. We would like to inform you once again about the development of our company and its research projects.

1. Our building extension is progressing

It is a great pleasure for us to see how our 450 m² extension building is continuously growing. Already in August, large reaction and batching tanks in our new production areas will be put in operation and thus significantly expand our filtration, shipping and storage capacities. With this expansion, we are taking account of the increased production and shipment costs and ensure that can we continue to deliver our products within 2 - 3 days.

In future, we will also have new and expanded offices, recreation rooms, sanitary facilities, and a large conference room. The extension is equipped with the most modern and safe technology. Our new roof is designed as eco-friendly green roof with shrubs, creating an attractive habitat for many insects – one of many contributions to a healthy environment.

In proven manner, we again collaborate with regional construction companies. This commitment to our region is returned; our enlargement was generously supported by the state of Brandenburg with a GRW grant.

LAND BRANDENBURG Investitionsbank des Landes Brandenburg ILB

Due to the positive economic development and our intensive research work, we are able to hire two more employees this year.

With respect to our production planning, comprehensive precautions were taken to ensure that even during the most difficult construction phase when old and new buildings are connected, all our customers can still be supplied on time.

Fig. 1 Walls are erected

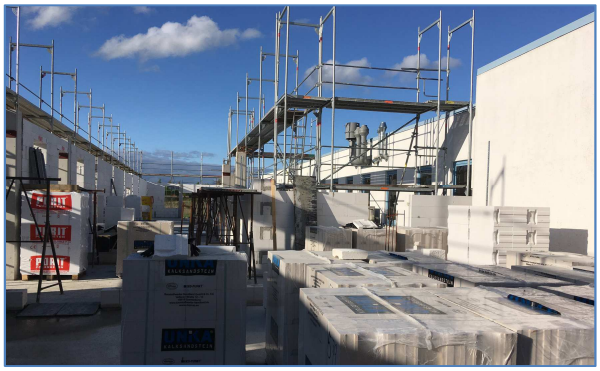

Fig. 2 Scaffolding for masons and roofers

2. Allresist at the congresses Triple Beam (EIPBN 2018) and MNE 2018

Our research department has been continuously successful in recent years. The new developments CSAR 62 and Electra 92 are meanwhile well established on the world market. Atlas 46, a further development of SU-8, and F-Protect 506 (an alternative for Cytop) are in the market launch phase. With Phoenix 82, we are now the only company worldwide which offers a resist for NanoFrazor technologies. Another new development is Medusa 82; already the first results turned out to be highly promising. The aim is here to produce an improved HSQ resist.

We present our very interesting new results in 2018 on the congress Triple Beam in Puerto Rico and also on the MNE in Copenhagen. Several abstracts for a presentation and the posters for the poster exhibition were already submitted.

Some of the results are shortly discussed in the following.

3. Atlas 46 variants for a selective two-layer build-up

This two-layer system has already been reported on in the last issue of the AR NEWS.

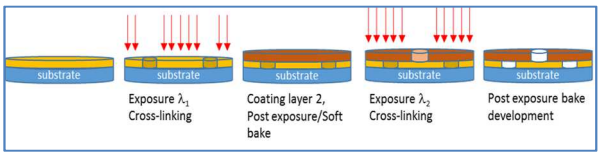

Fig. 3 Process flow 3D-multilayer system Atlas 46

New is the result of the following experiment: As bottom layer, AR-N 4600 S (which is not sensitive at g-line) is coated, irradiated and cross-linked. Then AR-N 4600 g-line (which can be structured at g-line) is applied on top, irradiated and cross-linked. After g-line exposure, only the top layer is cross-linked in exposed areas. This yields the following structures:

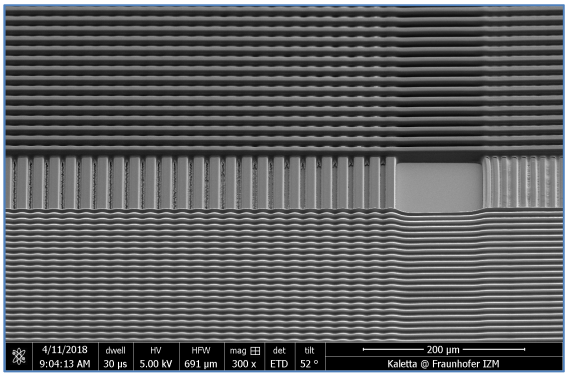

Fig. 4 Atlas 46 S (vertical bars) and Atlas 46 g-line (horizontal bars) after development

After a sufficiently long development step, it is possible to dissolve unexposed areas of bottom layer AR-N 4600 S and to generate tunnels or bridges.

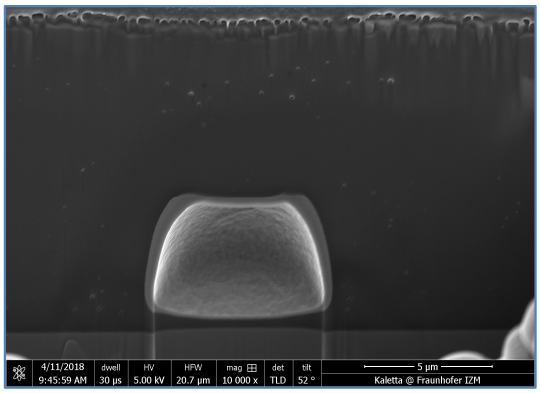

Fig. 5 Tunnel entrance in Atlas 46 S layer

The work to optimise process parameters is carried out in close cooperation with the IZM Berlin and will be presented at the MNE 2018.

4. Fluorescent resists for optics and sensors with Atlas 46 S

Fluorescent e-beam resists with CSAR 62 or PMMAs and coloured photoresists were also reported on in the last issue of the AR NEWS.

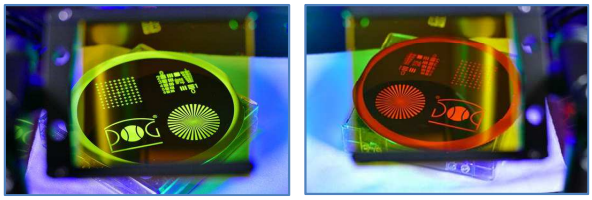

Fig. 6 Fluorescent e-beam structures with SX AR-P 672.08 (POG Gera); yellow-green (left) and red (right) fluorescence

New is the following result: Atlas 46 S was chosen as highly suitable base for permanently in substrates remaining fluorescent structures since these Atlas 46 S layers are very durable. Different fluorescent dyes were incorporated into the resists. It was even possible to apply differently coloured structures on one substrate:

Fig. 7 Green and red fluorescent resist structures on the same substrate (film thickness 3 µm)

The red version of Atlas 46 is coated, irradiated, cross-linked and developed. Thereafter, the green Atlas 46 version is spun onto the substrate. The red structures are completely covered during this step, but that does not matter because the green resist is later removed in the subsequent second development in all areas which are not irradiated. Irradiated green structures however then remain at the desired places. This process can be repeated with other colours.

It is of course also possible to irradiate in such a way that the structures of both resists partially overlap. In this case, mixed colours are created in these areas as shown in Figure 8 below.

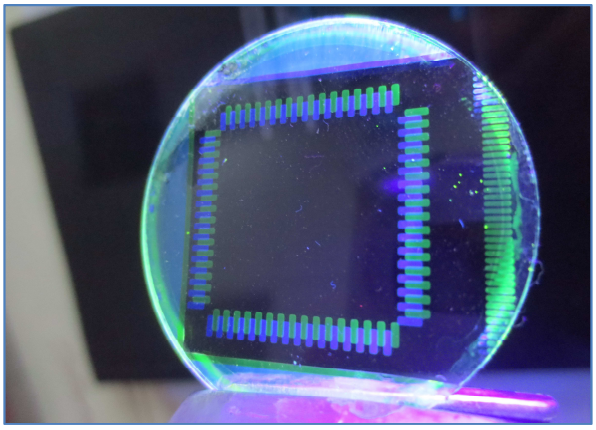

Fig. 8 Overlapping, fluorescent Atlas structures

The scope for design is even greater if a selective multilayer process as described under item 3 is used. For this purpose, the different Atlas 46 resists are mixed with different fluorescent dyes which allow the fabrication of e.g. red lines intersecting with green ones.

With these resists, we offer a coloured construction kit for the fabrication of fluorescent structures and would be pleased if you would see ideas and possibilities for your own projects.

5. Medusa 82 – a resist turning into "stone" structures

According to Greek mythology, anyone who dared to gaze into Medusa's eyes was turned into stone.

Fig. 9 Depiction of Medusa by Carlos Schwabe, 1890

Our newly developed resist however only needs electron beam lithography for this interesting transformation☺! We were inspired to this product development by many customer requests for an alternative which should be better processable than HSQ resists.

Based on a solution of a silsesquioxane derivative, thin films (100 nm) were prepared and e-beam irradiated at the Martin-Luther-Universität Halle-Wittenberg. Upon e-beam exposure, predominantly SiO_2 (which is sandstone in the broadest sense!) was produced. The required dose for a complete layer build-up of approximately 1000 □C/cm² can be determined from the dose scale.

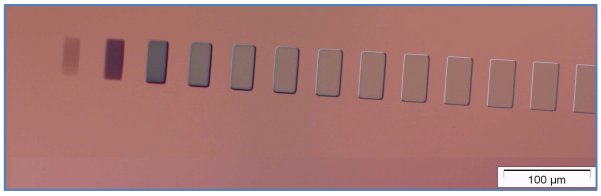

Fig. 10 Dose scale at 30 kV acceleration voltage, developer AR 300-44, 90 seconds

The process parameters are thus comparable to the parameters of HSQ resists. Our experiments also showed that Medusa 82 appears to be relatively robust with respect to processing properties since, in contrast to HSQ resists, even 7-day-old layers are still well processable. We will gladly inform you about this new development as soon as reliable results are available.

6. New protective coating for KOH/HF etchings – BlackProtect SX AR-PC 5000/41

Our long-standing protective coating SX AR-PC 5000/40 is used as an effective backside protection for 40 % KOH or concentrated HF solutions. A disadvantage of this resist is however the low temperature stability. Resist layers begin to soften already at 65 °C. This is particularly unfavourable during potassium hydroxide etchings which are usually performed at 85 °C.

That's why we were looking for new raw materials with higher melting point. The choice fell on a special hydrocarbon mixture with a melting point of 140 °C. This mixture could easily be processed into a resist now named SX AR-PC 5000/41, and resist layers are absolutely stable up to 130 °C. Due to the chemical properties, ethylbenzene is used as solvent. The resist is not attacked by solvents such as acetone, isopropanol, or PGMEA and is consequently also well suited as protective resist against these solvents.

For photolithographic processes however it must be taken into account that a cleaning with acetone is not possible. As remover, e.g. ethylbenzene is recommended.

Just like SX AR-PC 5000/40, the new resist BlackProtect can be structured as two-layer system.

This requires the following process steps:

1. Pre-coating with adhesion promoter
2. Coating BlackProtect SX AR-PC 5000/41
3. Tempering (95 °C)
4. Coating photoresist, e.g. AR-P 3250
5. Tempering, exposure and aqueous-alkaline development of AR-P 3250
6. Isotropic development of BlackProtect with developer X AR 300-74/5
7. Rinse/stopping

Due to more favourable raw material properties, the structuring of BlackProtect SX AR-PC 5000/41 is considerably easier as compared to a structuring of protective coating SX AR-PC 5000/40. It is not sensitive to light and simply washed out of the resist structures. The isotropic development results in the formation of funnel-shaped structures. Fig. 11 shows the concentric pattern of Newton's rings around the developed hole which was created by this effect. An isotropic development however also means that a resolution of < 10 µm cannot be achieved, while larger structures are transferred properly.

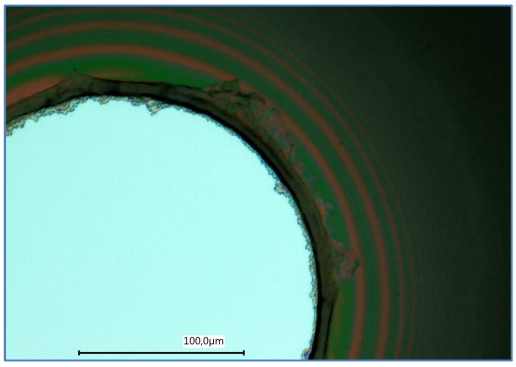

Fig. 11 BlackProtect layer (3 µm thick) after isotropic solvent development, hole diameter 200 µm

We hope that you found some interesting news and impulses – and appreciate your feedback. You are welcome to visit our stand on the **Triple Beam Conference (EIBPN) in Puerto Rico (29 May – 01 June)** and on the **MNE 2018 in Copenhagen (24 – 27 September 2018)**.

The next regular issue of the AR NEWS will be presented again in October 2018.

Until then, we wish you and us every success.

Strausberg, 26.04.2018

Matthias & Brigitte Schirmer in the Team of Allresist