AR NEWS

28th Issue, Mai 2014, Allresist GmbH

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Welcome to our 28th issue of the AR NEWS! And again is our goal to inform you about the most recent developments of our company and about ongoing research projects.

1. News about Allresist:
Extension for higher production capacities

As already mentioned in our last AR NEWS, the year 2013 was very successful for us. Product sales increased by 28 % and we were able to acquire a large number of new customers, among them a disproportionally high number of foreign customers.

In the summer of 2013 we finally decided to increase our production capacities, in particular for our new e-beam resist CSAR 62. Approximately 300 000 € are provided for extending the company building by 20 %, and also the funding of the Federal State of Brandenburg we applied for is meanwhile granted.

The extension will be built from June until September 2014. Between mid-July and mid-August, the new construction will be connected with the existing building, and extended delivery times may consequently be possible during this period. We thus recommend to stock items until the beginning of July for urgent orders.

Second-placed entrepreneur of the Federal State of Brandenburg In the competition "Entrepreneur of the State of Brandenburg 2014", Mrs Brigitte Schirmer was honoured with an award for the 2nd place. In additon to a recognition of the excellent personal achievements of the managing director in leading and strategically aligning the Allresist, this award also appreciates the cooperate philosophy of this small Business of Excellence. The award was presented by Minister President Dr. Dietmar Woidke and Minister Ralf Christoffers.

Fig. 1 Minister Baaske, presenting the award to Brigitte Schirmer

Innovation Prize Berlin Brandenburg 2014
The new development and successful marketing of e-beam resist CSAR 62 was subject of our application for the Innovation Prize Berlin Brandenburg for polymers and chemistry. As nominated company, we were invited to the awards ceremony by the jury under the direction of Brandenburg's Minister of Economy Ralf Christoffers. Allresist won and received the award during the Cluster Conference on May 5, 2014.

Fig. 2 Certificate presented to Mathias and Brigitte Schirmer

2. Conductive protective coating for e-beam lithography SX AR-PC 5000/90.2

We reported already in the last AR-News briefly about our new conductive coating SX AR-PC 5000/90.2 (based on a polyaniline derivative) which is much better suited for the coating of all e-beam resists as compared to its predecessor. In proven collaboration with the IDM, the synthesis of the polyaniline derivative and the coating properties of this resist were further optimised in the past few weeks. In addition, the very promising experimental results of test series conducted at the MLU Halle were meanwhile also confirmed by other users, among them the company Raith. The qualifying phase is thus more or less completed and samples of SX AR-PC 5000/90.2 are available as of May 2014.

Resist SX AR-PC 5000/90.2 can, just like SX AR-PC 5000/90.1, be used as conductive coating to prevent a charging during e-beam lithography. These charges cause highly disturbing effects in particular on quartz substrates and GaAs. In contrast to the previous resist SX AR-PC 5000/90.1 however, the new SX AR-PC 5000/90.2 can also be used for novolac-based resists (AR-N 7500, AR-N 7520, AR-N 7700, AR-N 7720, AR-P 7400, X AR-N 7700/30) since the aqueous solution does not attack the resist surfaces.

SX AR-PC 5000/90.2 is furthermore characterised by a higher conductivity and can, in contrast to /90.1, be more easily removed with water even after extensive exposure. The conductive polymer used for the resist shows basically no tendency to form insoluble cross-linked structures.

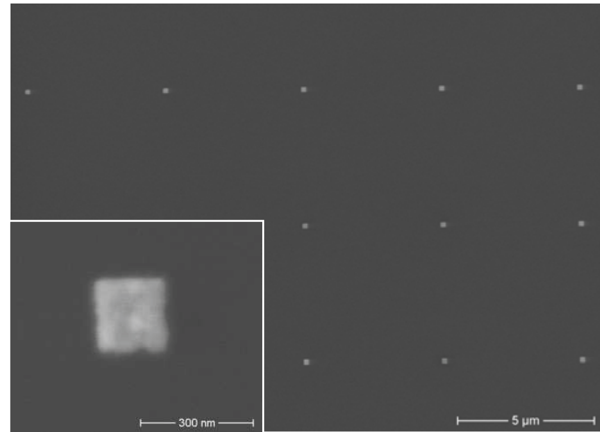

Fig. 3 200-nm Ti/gold squares, spacing of 5 µm on 1 mm glass (object slide)

3. E-beam resist SX AR-N 7530/1 for white light applications

Process-stable negative resist systems which allow resolutions of < 30 nm with sufficiently high sensitivity are of increasing interest for applications in electron beam lithography. Even though many chemically enhanced e-beam resists are characterised by a very high sensitivity, are they nevertheless only suitable for the fabrication of structures up to a resolution of approximately 60 nm. Non-chemically enhanced e-beam resists (e.g. AR-N 7500) do have the potential for resolutions of < 30 nm, but these resists are less sensitive and consequently require long writing times.

Since the middle of 2012, our new highly sensitive negative e-beam resist AR-N 7520 new (former name: SX AR-N 7520/4) is on the market, which provides structural resolutions of about 30 nm at a very high sensitivity and also shows a very high long-term stability. Resist AR-N 7520 new has to be processed under yellow light conditions since this resist is also characterised by a high light sensitivity in the wavelength range between 300 – 380 nm.

With resist SX AR-N 7530/1 (former name: SX AR-N 7520/15.4), we now present a new negative-working e-beam resist which can also be processed under white light conditions and which has comparable good properties like the meanwhile

well-established resist AR-N 7520 new. SX AR-N 7530/1 also allows to achieve resolutions of up to approximately 30 nm with equal sensitivity. This resist is suitable for UV-structurings in the wavelength range between 250 and 290 nm and can thus also be used for mix&match applications under these conditions.

The dose-dependency of the structural width is exemplarily demonstrated for SX AR-N 7530/1 in the following figures 4 and 5. At a structural width of 5 µm, only a dose of approx. 13 µC/cm² (30 kV) is required. For 100 nm-lines however, the required dose is in a range between 35 – 40 µC/cm² (see Fig. 5). Quite similar results were also obtained for AR-N 7520 new.

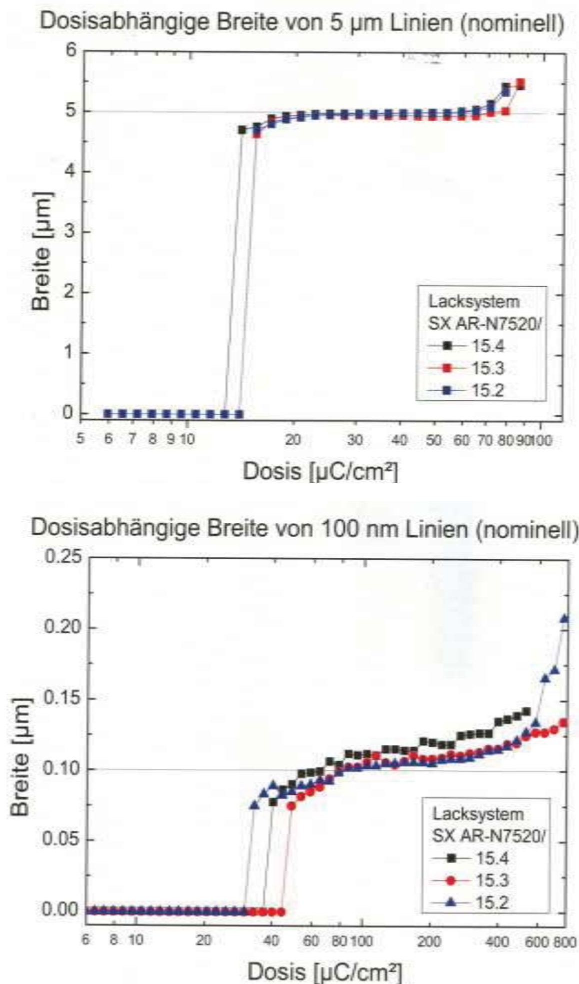

Fig. 4 + 5: Dose-dependent width of lines

With resist SX AR-N 7530/1, structures of 35 nm were produced in gold quality (see Fig. 6).

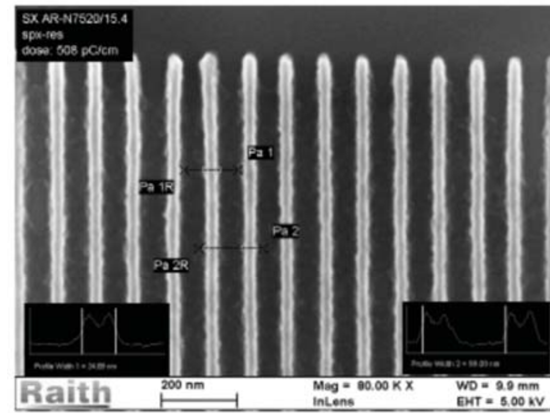

Fig. 6: 35 nm-bars with sample SX AR-N 7530/1

E-beam resist SX AR-N 7530/1 is available as of May 2014 for our customers.

4. AR-P 3540 MIF – a resist which can do more!

As usual, we are offering our partners the possibility to present their experiences and results in our AR NEWS.

From Thuringia, Klaus-Dieter Preuß - development engineer in the CiS Research Institute for Micro Sensor Technology and Photovoltaics GmbH, as well as Dr. Axel Weidner - managing director of the company ML Microlithography Service GmbH Jena, report:

It's already some time ago that the Allresist GmbH and the CiS Research Institute for Micro Sensor Technology and Photovoltaics GmbH together developed the first metal ion-free positive resist with the corresponding metal ion-free developer AR 300-475 and thinner AR 300-12.

Background of this development was the relatively high Na^+ concentration of > 3,88 ...10,11 × 10^{11} cm^{-2} in the standard resist system AR-P 354 with developer AR 300-48 which was used at that time.

Innovative products of microelectronics and microsystems technology are currently characterised by a fast increase in functionality and reliability. This trend development is inevitably associated with an ongoing further development of process chemicals.

The testing of first samples of the Na^+-free resist system in a CiS wafer process was carried out to realise, in addition to the technical innovation and the attainment of an accepted threshold value for possible Na^+-ions in the resist, for example the following other goals:

- possibility to positively influence the electrical parameters of sensors

- defined base for the introduction of new technological procedures in the manufacturing process of sensors.

On May 12, 2005, the wait was finally over, at 3.06 a.m. all coating systems in the CiS wafer process were switched to the new “Na^+-free resist system“ with AR-P 3540 MIF/AR 300-475. During the introductory phase from 12.05.2005 to 16.06.2005, no problems occurred. We have meanwhile bought already several thousand litres of AR-P 3540 MIF from the Allresist GmbH and processed this resist successfully in the wafer process of the CiS.

So much for the history – but the success story does not end here. The CiS as partner for production-oriented research and development of new sensor solutions and microsystems meets also demands of application- and market related research tasks on the behalf of the public sector. The institute is thus both oriented towards the priority focus of European research programs and research projects of the Federal Government and the Federal States.

We currently work among others on the project “RadioMed“ termed from 01.07.2012 to 30.04.201. Resist AR-P 3540 MIF plays an important role in this project.

By combining classical mask-based exposure procedures (contact-, proximity- and projection exposure) with modern maskless lithography (laser- and electron beam exposure), is this project intended to create the preconditions to conduct all structuring services up to the sub-micron range.

With these works, the RadioMed-project is targeted to increase the user efficiency of exposure techniques, in particular in the form of mix&match procedures for MEMS and sensory processes.

In analogy to known photolithographic structurings, resist AR-P 3540 MIF is in this case chemically altered by controlled laser beam exposure and removed in the subsequent development step. In test series, new application fields for the AR-P 3540 MIF in the maskless lithography are now assessed and evaluated.

Since currently both the resources and the knowhow for laser lithography in the CiS Research Institute are lacking, the RadioMed-project works in close cooperation with the ML Microlithography Service GmbH Jena, which is a long-term experienced and competent service provider for photo lithography (emerged from ML&C Jena; now: Compugraphics Jena GmbH).

Within the context of this project, all intended co-operations with respect to laser beam lithography will be realised at the ML Service GmbH using the DWL 66 device as shown in Fig. 7.

Fig. 7 Laser beam exposure device DWL 66

First results are demonstrated in figures 7 and 8 - with positive success, since resolutions of less than 1.0 µm were obtained.

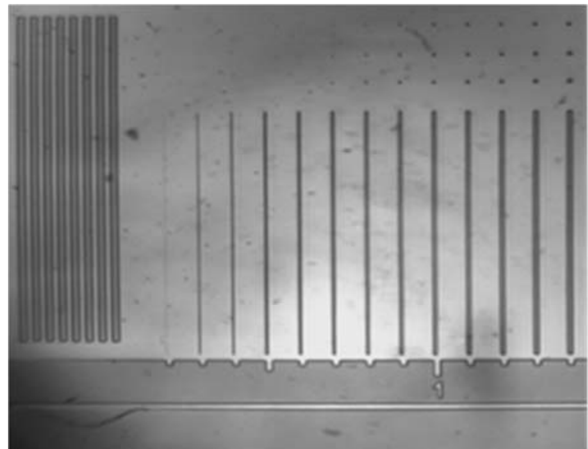

Fig. 8 Resolution of structures (bars) <1.0 µm in AR-P 3540 MIF

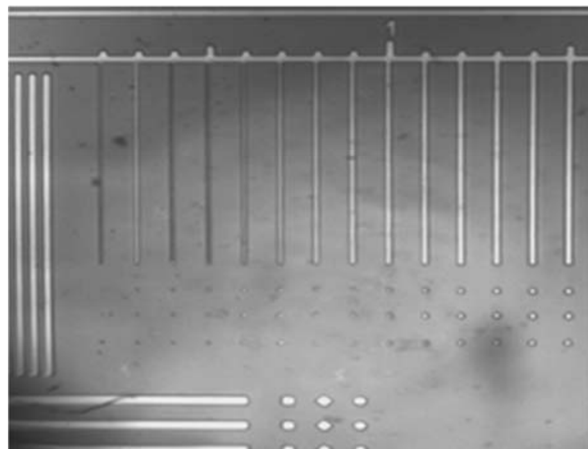

Fig. 9 Resolution of structures (gaps) <1.0 µm in AR-P 3540 MIF

5. Allresist on the Semicon China 2014

Together with our partners in China, GermanTech Ltd., Beijing, and the German Innovation Center, Changzhou, Allresist was represented at the fair Semicon China from 18. – 20. March 2014. The interest in our products of the predominantly Chinese customers was high, and many points of contact developed for future cooperations. One highlight was the visit of Prof. Baoqin Chen, Leader of the Institute of Microelectronics Chinese Academy of Sciences, the leading authority in the field of electron beam lithography in China. Prof. Chen also confirmed very good results with our e-beam resist CSAR 62 and expressed his pleasure about the in-depth professional discussions which took place in Beijing.

Fig. 10 Visit of Prof. Baoqin Chen at our stand

We were represented with an own exhibition stand in the "German Pavilion" and could thus specifically strengthen the good reputation of products "Made in Germany" on this occasion.

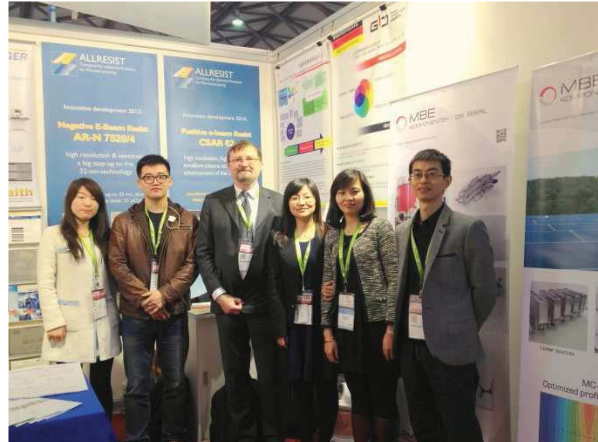

Fig. 11 Exhibition stand team Semicon Shanghai

The visit in China was also a welcomed opportunity to visit some of our current and future customers. In China, the interest in our products is as high as in Europe. In this respect, business relationships between Chinese customers and Allresist will be deepened further with the help of our Chinese partners.

It is always a particular pleasure for us to visit China and to enjoy the hospitality of this country. This is one of many reasons why we cherish the positive development of our foreign business relations with China.

We hope to have offered a few interesting ideas also for you and strongly encourage you to communicate all your requests.

Our next issue of the AR NEWS will again be presented in October 2014.

Successful times until then!

Strausberg, 06.05.2014
Matthias & Brigitte Schirmer
Team of Allresist