AR NEWS

15th Issue

Allresist GmbH

Contents:

Registration-No. 12 100 15718 TMS

1. Allresist on the way to excellence

Valued reader of the AR NEWS, we would like to inform you again about the further development of the Allresist and our products: In the following articles, we will present the latest news from our research. We wish and hope that these news will spark your interest and might even encourage a stimulating and productive cooperation in the future.

1.1 Successful QMS re-audit

Six years after the introduction of a quality management system according to DIN EN ISO 9001:2000, a second QMS re-audit was due according to schedule. Based on our management reviews, our auditor Dr. Leonhardt of the „TÜV Süd Gruppe“ was informed about all results and goals. He assessed all business processes and convinced himself of the respective system conformity. He was especially impressed by the efficient functioning our new ERP business software which controls all processes and procedures. Dr. Leonhardt could not detect any deviations from the standard and authorised a new certificate to be issued. He also wished us success for our way to develop into a Business of Excellence and for our application at the Quality Award Berlin/Brandenburg 2008 in this regard.

1.2 Contract with a Taiwanese trading company - new customers in Taiwan, Korea, and China

In 2007, promising new contacts were established with a Taiwanese trading company which was in search for German high tech products for its customers. This company showed greatest interest in our photoresists, particularly in our recent development CAR 44.

A trade agreement was jointly concluded concerning the delivery of large quantities of this resist. The contract was signed at the end of March during a visit of the general manager Matthias Schirmer at the Taiwanese partners. We will thus most likely be able to arrive our strategic goal of increasing the sales volume to more than 1 Mio. € already in 2009.

Continuing this journey through Asia, also business partners in Korea and China (Beijing) were visited. On this occasion, strategic goals were mutually agreed upon and prospective customers visited. New resist developments such as CAR 44 and the e-beam resist AR-N 7520 aroused highest interest in users. The trade with Asia will considerably expand within the next few months.

Picture 1: Business meeting with the executive board of Prosperchem Inc. in Taipei

2. New spray resist family: positive and negative spray resists

The range of applications where spray coaters are utilised for protective coatings is steadily increasing. This however conflicts with the fact that spray resists are more or less commercially unavailable. Manufacturers of spray coaters typically recommend to customers to dilute a resists with methyl ethyl ketone (MEK) or acetone themselves when required. Only resist AZ 4999 is available for purchase. The composition of the AZ 4999 resist guarantees a very good covering of surface topologies, but the coating surface is very rough. In addition, a large number of beads are generated which interfere with certain processes. Moreover, the resist tends to form blisters in the tubes of the spray coater which is caused by the low boiling point of the solvent mixture.

Many customer requests in this regard motivated us to develop new spray coatings and to provide an entire family of ready-to-use spray resists (positive, negative, protective coating). Optimisations were mainly performed using the GAMMA Altaspray spray coater provided by Süss MicroTec. The good results obtained here can however easily be adapted to the equipment supplied by other manufacturers.

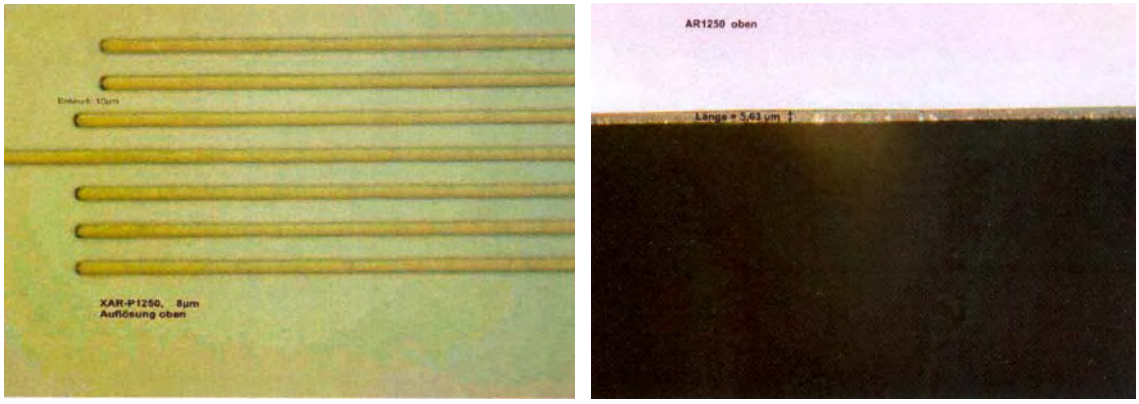
Our concept was based on the assumption that it is not sufficient to mix the standard high boiling point solvent PMA (PGMA) with very low boiling point solvents (acetone, MEK). Therefore, several 3- and 4-sovent mixtures were assessed. The bake properties were adjusted in such a way that a good edge coverage could be achieved. With the addition of medium boiling point solvents, the films however remained sufficiently moist to allow for a smoothening of the resist surface during the bake step.

First experiments with these spray coatings were carried out by Mr. Nüske, Fraunhofer IPMS, Dresden. In the following table, the process parameters are summarised.

Table 1 Process parameters (spray coater: GAMMA Altaspray,)

Parameter	SX AR-P 1250 (positive coating)	SX AR-N 2250 (negative coating)
N_2-pressure	1.1 bar	0.9 bar
Y-speed	85 mm/s	65 mm/s
Chuck temperature	82.5 °C	82.5 °C
Spray height	22 mm	15 mm
Soft bake	90 °C, 5 min	100 °C, 6 min
Cavity depth (sidewall angle 54°)	200 µm	510 µm
Film thickness (top; edge; bottom)	7 – 8 µm; 4 µm; 3 - 5 µm	8 – 9 µm; 4 µm; 4 - 6 µm
Minimum resolution (top)	< 10 µm, very smooth resist edges	< 10 µm, very smooth resist edges

The results were summarised by Mr. Nüske as follows: “The spray resists can easily be sprayed, generating and a smooth resist surface. The coating contains only very few blisters/particles. Notably the cavity floor is flat and smooth. The upper edge of the cavity is reliably covered (50 % thickness of planar surface). The most critical areas are in the vicinity of the lower edge of the cavity. The resists do not form gas bubbles in the tubes, which facilitates the handling within the apparatus.”



Picture 2 Dependent on the film thickness, the resolution averages 5 – 10 µm (left), the coating homogeneity is very good, and the surface is smooth (right)

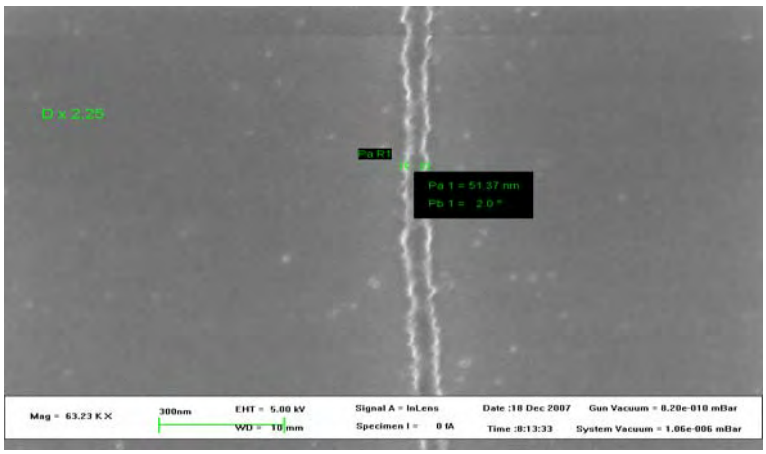
The negative and positive spray coating are complemented by the protective coating SX AR-PC 5000/3. This protective coating can also be applied with spray coating procedures.

☞ The development work concerning this system is not yet finished. In the context of this project, features will be optimised further. We would greatly appreciate if you should be interested to test our resists with your specific spray coater.

3. AR-N 7700 – good resolution with high sensitivity

In our 14. issue of the AR NEWS we reported on the development of a highly sensitive e-beam resist SX AR-N 7700/37. At that time, the too low resolution of only 300 nm still caused problems. Now the team of Dr. Schmidt of the Physical Institute, University of Würzburg, was able to improve the resolution while all the other good parameters remained unchanged.

Film thickness:	120 nm
Soft bake:	85 °C
Sensitivity (20 kV):	3,38 µC/cm²
Cross linking bake:	105 °C, 2 min hot plate
Developer:	AR 300-47 (2,5 : 1 diluted)



Picture 3
Minimum resolution of 50 nm with e-beam resist SX AR-N 7700/37

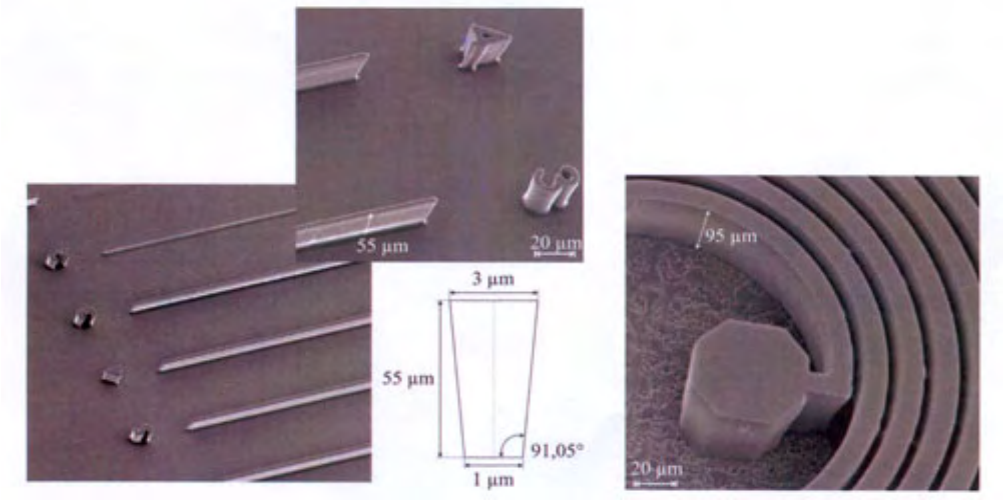
A resolution of 50 nm represents a very good result for a chemically amplified resist with a sensitivity of 3 µC/cm². The accuracy of edges however, as demonstrated in picture 3, is still insufficient. By modifying the resist composition and an optimisation of the process parameters, we intend to improve the structural quality up to the point where this resist is suitable for an application in industry, e.g. for the production of masks. We shall be glad to inform you in our next AR NEWS about the progress of this work.

4. Report on the features of CAR 44 in galvanoforming

Dr. Marco Feldmann from the Institute for Microtechnology, Technical University of Braunschweig, also investigated CAR 44 in the context of his dissertation. Here, we present excerpts from this work which describe the application features of AR-N 4400. The complete dissertation is accessible (please see citation as given below):

"With the development of CAR 44, now a negative resist is available which represents, due to the specific advantages and disadvantages in comparison to positive resists and the SU-8, an attractive alternative for specific applications. Film thickness values between 10 – 180 µm can be obtained with a single coating step, since formulations with various viscosity exist. The bake step may entirely be performed on hot plates at a maximum temperature of 95 °C and bake times corresponding to the respective film thickness (1 min/µm). It became evident that the use of temperature ramps to minimise the dry skin effect and internal tension is not necessarily required for CAR 44, but it also does not interfere. The bake is subsequently followed by the exposure. In order to avoid a loss of adhesion and underdevelopment, it is absolutely essential to allow for a sufficient polymerisation even of the deep layers and to chose the exposure times accordingly. Dependent of the film thickness, the exposure doses display linear characteristics of 26 mJ/cm² per micrometer.

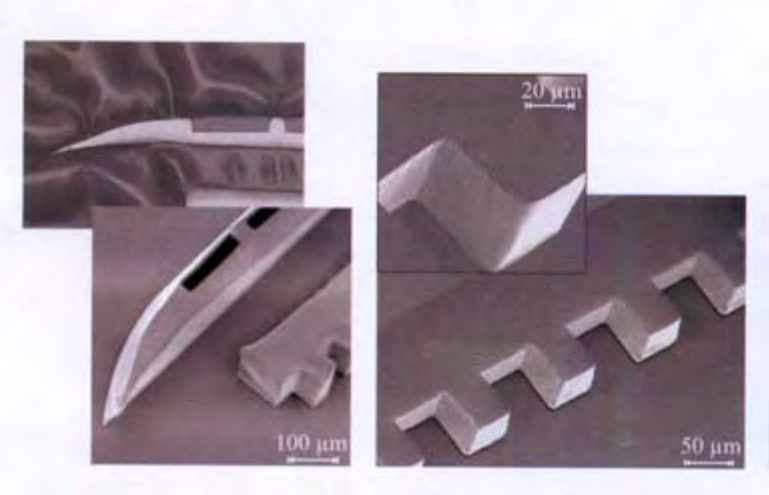
After exposure, the temperature step (PEB) is carried out at 95 °C, which is important for cross linking and may also be performed on hot plates. Here also no temperature ramps are required, since in contrast to SU-8 no surface tension occurs which might negatively influence the pattern quality. For the subsequent development step, several developers are available which differ with respect to their concentration (AR 300-47, -46). The development is performed at room temperature via an immersion process which is supported by megasound. Agitation allows for a quick development even into the deep layers which also reduces the corrosion of the cross-linked photoresist. Using this optimised process protocol, structures with an aspect ratio of more than 18 : 1 at a sidewall angle of 91.05° could be generated (see picture 4).



Picture 4 Aspect ratios and slope angles of CAR 44 as determined on the basis of test structures

A throughout good adhesion could be determined for all substrates used as well as on metallic surfaces. Comparing now CAR 44 with the characteristic features of AZ 9260 and SU-8, CAR 44 appears to be rather an alternative for the application range of AZ 9260, in particular for galvanoforming. This

is mainly based on the higher aspect ratio which can be obtained due to the easy removability with solvents such as acetone. Especially the fact that here a negative resist is concerned, where non-exposed areas or those areas which are relevant for galvanoforming always remain developable, predestines CAR 44 for galvanic deposition. This is also supported by the comparatively simple process management which involves no time-consuming bake and cooling steps. Furthermore, with a single coating step film thickness values are possible which can only be achieved for AZ 9260 with multiple coatings and bake steps in between. CAR 44 possesses a high chemical and thermal stability, permitting an application in galvanic processes at temperatures > 50 °C. Under these conditions, AZ 9260 softens after a hard bake, and structures to be generated are distorted. In contrast, CAR 44 remains inherently stable and displays steeper sidewall geometries, due to the higher aspect ratio. (see picture 5) …[1]“



Picture 5 left: Structural instability of AZ 9260 after 50°C galvanising in contrast to galvanic deposition of structures in inherently stable CAR 44 galvanoforms (right)

[1] Dissertation „Technologien und Applikationen der UV-Tiefenlithographie: Mikroaktorik, Mikrosensorik und Mikrofluidik“, Dr. Marco Feldmann, Institut für Mikrotechnik, TU Braunschweig, ISBN 978-3-8322-6146-7

With this presentation of our recent results, we hope to have encouraged you to address new applications with our photoresists.

The next issue of the AR NEWS will be presented on our company’s 16th anniversary in October of this year.

Successful times until then!

Strausberg, April 16, 2008

Matthias & Brigitte Schirmer

Allresist Team