

# AR NEWS

21<sup>st</sup> Issue, October 2010

**Allresist GmbH**

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Welcome to our 21st issue of the AR NEWS, presented on time on our 18th anniversary October 16. We would like to inform you again about the further development of our company and our recent research projects:

## **1. Allresist receives Quality Award Berlin-Brandenburg 2010**

Both Ministers for Economics of Berlin and of Brandenburg, Harald Wolf and Ralf Christoffers, presented the awards for outstanding economical top performance and excellent quality management to the winners of the Quality Award Berlin-Brandenburg 2010 on September 22. Participants of the competition are divided into four categories depending on the company size.

**In the category of up to 20 employees, the Allresist Company achieved an excellent result and scored exceptionally high.**

The assessment is based on the internationally accepted EFQM model (European Foundation of Quality Management). Foundation pillars of this model are customer orientation, process optimization, innovation and employee involvement, as well as a sustained positive corporate development. According to the holistic management mode, also social aspects were taken into account such as the reconciliation of interests between all partners and the general corporate social responsibility, e.g. particularly the consideration of environmental issues.

This is the reason why in addition to both Ministers for Economics, also the Minister for Environment, Public Health and Consumer Protection, Anita Tack, attended the award ceremony. She supports the Allresist Company already for many years on the way to Business Excellence, and also this year when the environmental management system according to DIN 14001 was introduced.



Team of Allresist on the occasion of the award ceremony at the town hall (Rotes Rathaus) of Berlin

The managing director of Allresist, Brigitte Schirmer, was appointed Ambassador for Ex-

cellence. With high commitment, she will promote the idea of excellence in Berlin-Brandenburg and inspire as many other companies as possible for the EFQM model.

In the view of the jury, the Allresist Company has continuously proceeded on the way to Business Excellence. The team of assessors was extremely impressed by the variety of management tools applied, with which the Allresist gained a very good position on the world market. The key vision to become market leader for customer-specific photoresists was implemented successfully with enthusiastic employees and excellent customer partnerships. Remarkable are also the exemplary work processes which are - integrated into a process map - professionally controlled by a balanced scorecard. The long-lasting intensive cooperation with research facilities in which Allresist operates as link between industry and research

ensures a long-term success for the future. In the context of memberships in scientific organizations and trade associations and continued and successful applications in challenging business competitions, this effort led to an excellent performance.

The Quality Award Berlin-Brandenburg is one of seven regional awards for quality management of the German States. Established in 2002, it is offered biennially by the Berlin Senate Administration for Economy, Technology and Women and the Ministry of Economics and European Affairs of Brandenburg. The Quality Award Berlin-Brandenburg is presented to the winners during a ceremony in September 2010 in Berlin. Aim of the Quality Award is to promote and to reinforce the economic region and the companies located there, setting a signal for all those who face the major challenge of Business Excellence.

## 2. New Negative E-Beam resist AR-N 7520 presented on the MNE 2010

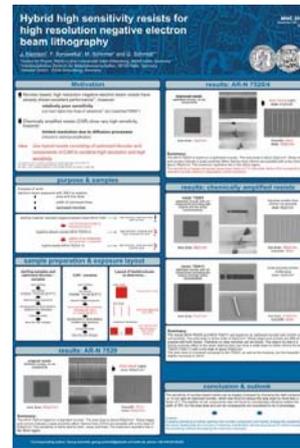
In collaboration with the Martin-Luther-University of Halle, Institute of Physics led by Prof. Georg Schmidt, our standard electron beam resist AR-N 7520 was optimized. The goal was not to achieve a purely academic maximum performance with respect to resolution ( $< 10$  nm), but to develop an e-beam resist suitable for real structures with a resolution of  $\leq 30$  nm. The sensitivity should be sufficiently high to pattern wafers in a reasonable write time. The entire process should be simple, robust and compatible with the existing e-beam equipment.

Results as presented in the poster [1] demonstrate that the goal has largely been achieved already. Due to the use of new novolacs and new cross linkers which work according to the radical method it was possible to increase the sensitivity substantially. The area dose for  $4 \times 4 \mu\text{m}$  squares was approx.  $250 \mu\text{C}/\text{cm}^2$  (30 kV) for the standard resist, while the optimized AR-N 7520/4 required only  $33 \mu\text{C}/\text{cm}^2$  (7.5-fold increase). For the single lines written (40 nm lines at a film thickness of 100 nm), the doses could be reduced from 630 pC/cm to 163 pC/cm (factor of 4). This resist is not chemically amplified and therefore extremely robust during the process, providing also an excellent resolution (no diffusion and only low proximity effect, respectively). With these results, the BMWi-supported project "E-beam resists for mask production" (INNO-WATT) can be successfully completed. We would like to offer the opportunity to all interested users to test samples of our new, more sensitive resists already at this stage.

In order to further increase the sensitivity, so-called hybrid resists were designed in subsequent experiments. Further components for chemical amplification were added to the improved e-beam resist AR-N 7520/4. First results showed no significant improvement, reflecting the increased proximity effect associated with these resists. With an appropriate proximity correction and an optimization of process parameters, potential advantages of these hybrid resists will however become fully apparent. For us it is important that our customers become engaged in the final studies and thus contribute to the success of this project.

[1] **“Hybrid high sensitivity resists for high resolution negative electron beam lithography”**

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**3. Optimization of thick negative resist AR-N 4400**

Meanwhile, a large number of customers use resists of the AR-N 4400 (CAR 44) series regularly. A simple handling, the aqueous-alkaline development and most of all the easy removal are appreciated by users. Originally, these resists were specifically developed for microsystems technology (synchrotron). One possible application is e.g. the fabrication of X-ray masks for LIGA technology [2]. However, an optimization for synchrotron radiation requires a lower content of photoactive acid generator (PAG), since otherwise a foot forms at the “bottom” of the structures, due to a backscattering of radiation from the substrate (see Fig. 2). With an appropriate concentration of PAG, very good structures can be obtained (see Fig. 3).

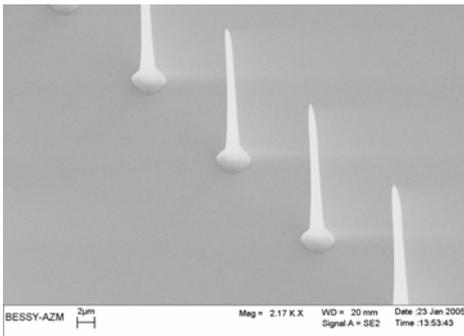


Fig. 2 Extreme footing, PAG content too high

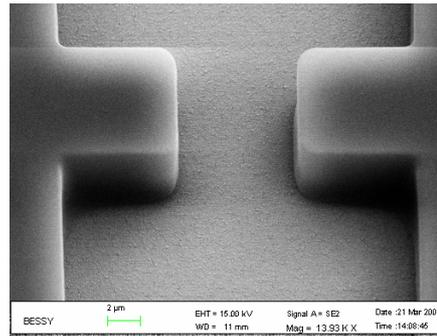


Fig. 3 Structures for a gold mask with AR-N 4400-10

Further investigations of these negative resists revealed that this particular composition was not optimal for UV lithography. A selective increase of the PAG content increased the sensitivity by a factor of 5. The structural quality can be considered as very good (see Fig. 4 + 5). For lift-off applications (AR-N 4450-10), the original composition was maintained, the high PAG-content results in a higher contrast and prevents the formation of undercuts. First improved samples for own test trials will be available in the near future.

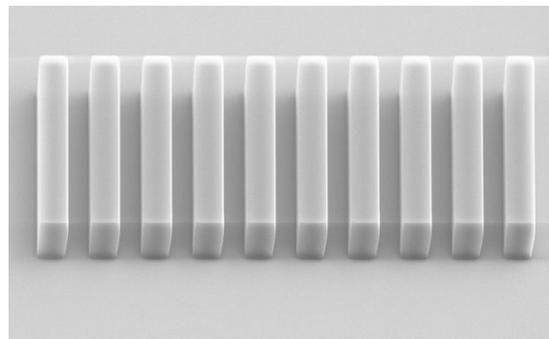
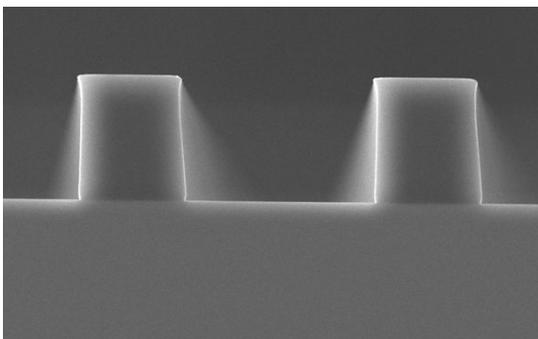


Fig. 4 and 5 Structures with AR-N 4400 (CAR 44) improved for UV lithography

[2] **Fabrication of X-ray Masks in a Two-Step Process using CAR 44 Photoresist**

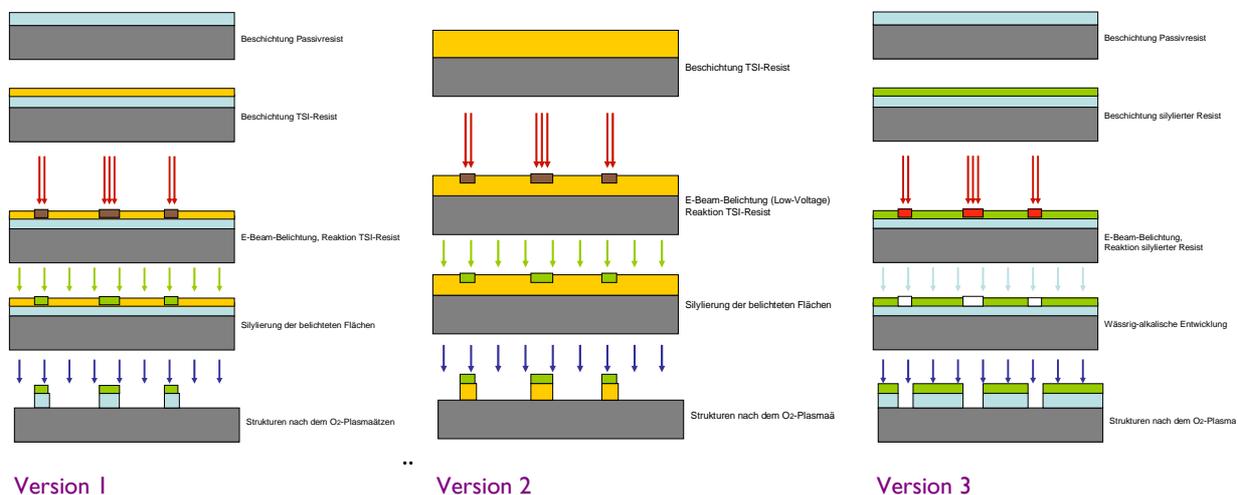
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#### 4. Work started to develop a top surface imaging resist

Goal of this project was to develop top surface imaging (TSI) resists specifically optimized for low voltage electron beam lithography, and to test possible fields of application in silicon technology. Using these TSI resists, the resist is modified by exposure in such a way that exposed areas can subsequently be selectively hardened close to the surface with silicon-organic compounds. The development is then carried out by oxygen plasma etching. The use of these resists in e-beam lithography gives the possibility to work with extremely low acceleration voltages. With TSI technology, the required penetration depth can be reduced and, while maintaining the extremely high resolution, the usable resist thickness can be drastically increased.

In addition, these new resists can also be employed for higher acceleration voltages (see version 1 + 3). Using a robust passive resist as bottom resist, one- and two-component systems, chemically amplified and non-amplified resists (positive and negative) as well as already silylated polymers will be assessed. The silylation step is again carried out with different methods. In collaboration with our long-standing partners IDM e.V., MLU Halle and Raith GmbH, we will now start these investigations.

Fig. 5 Different examples for TSI-technology applications with newly developed resists



We strongly encourage all interested parties to get involved at an early stage and to inform us about your wishes, requirements and comments.

We hope to have encouraged you with this presentation of our recent research activities and look forward to a constructive and creative cooperation.

Please visit us also on the **SEMICON EUROPA 2010** from **October 19-21, 2010** in **Dresden, hall 4, stand number 4226**.



The next issue of the AR NEWS will again be presented in April 2011. Successful times until then!

Strausberg, October 16, 2010

Matthias & Brigitte Schirmer

Team of Allresist