# AR NEWS

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## Allresist GmbH

**Contents:**



Welcome to the 23rd issue of the AR NEWS, traditionally presented on our company anniversary on October 16, meanwhile the nineteenth. We would like to inform you again about the further development of the company and its current research projects:

## 1. Our nineteenth business year

The 19th business year so far developed extremely successful, we were able to increase our sales further beyond the plan. The turnover with our foreign customers increased above average, reaching 27 %.
In addition to an increase in personnel, large investments were made in new measurement equipments. With the FTP 500 (Sentech Instruments) and the Dektak 150 (Veeco Instruments), we are now able to realize the broad range of product developments in close cooperation with our customers even faster and more effectively.

In other terms, we enhanced our ability to develop new resists according to the market requirements. First results of our most interesting new product developments are presented in the last section of this issue.

We also further pursued the concept of excellence this year. Together with the Ministers for Economics of Berlin and of Brandenburg, Ralf Christoffers, the Ambassador for Excellence Frau Brigitte Schirmer announced the Quality Award Berlin-Brandenburg 2012. Matthias Schirmer participated as assessor in the Ludwig-Erhard Award process and evaluated a Thuringian company.

We would like to use this opportunity to thank you, our customers, for the trusting collaboration and already now kindly ask you to keep in mind that our 20th company anniversary which we would like to celebrate together with many of our partners will be in autumn 2012.

You will be informed in time about this event.


Fig. 1+2 Public offer of the quality award 2012

## 2. A two-layer resist system for hydrofluoric acid etchings – SX AR-N 5000/40

The development of a photolithographic procedure for the etching of glass or silicon dioxide has successfully been completed. Reports concerning the progress of this project were already published in the last issues of the AR NEWS. Both for utilization as unpatterned protective layer as well as for a targeted patterning thereof in positive and negative two-component patterning processes, now comprehensive results are available:

The protective layer itself was assessed with respect to long-term stability in the presence of various HF concentrations. In concentrated HF etching solution (48 %), a 20-μm-thick layer is stable for at least four hours. This time span is correspondingly extended to up to 10 hours if a diluted hydrofluoric acid solution is applied, thus reaching the technologically practicable upper limit. Thinner resist films of 5-10 μm are resistant to concentrated acid solutions for up to two hours, while the protective effect is again extended to several hours in diluted hydrofluoric acid solutions (10 % and 24 %, respectively).

In order to obtain a high quality of resist films, a pretreatment of the glass substrate with adhesion promoter is recommended. Resist films should furthermore not be baked at temperatures above 60°C. Removal and cleaning of the equipment can easily be performed with the organic remover X AR 300-74/1.

We were able to employ the negative resist AR-N 4400-10 as top layer for the two-layer system. In addition to providing high flexibility for the user who now has the choice between a positive or negative image, also a higher resolution and improved handling features were achieved for this process. Unexposed areas of the negative resist which are developed in the first aqueous-alkaline development step can easily be completely removed so that during the second organic development step the HF-resistant polymer is immediately dissolved. Resist residuals on the polymer surface would otherwise interfere with the second development. With a careful choice of the organic solvent mixture, an optimum development speed for developer AR 300-74/1 could be obtained.

As particularly advantageous for a high structural quality turned out to be a pretreatment of the glass surface with adhesion promoter AR 300-80. Etched structures were assessed using a photo mask with defined line width, and measurements were performed with our new Dektak 150. During each isotropic etching, inevitably undercuts occur. These undercuts are smaller if the adhesion between glass surface and protective layer is very high. If the adhesion is insufficient, the resist film is however basically stripped off during the etching. Measuring depth and width of the etched trenches is highly indicative of the adhesion quality. A larger width of the trenches correlates with lower adhesion features. In Fig. 1, a measurement series is shown as example. Etched trenches were measured several times at different positions and evaluated.

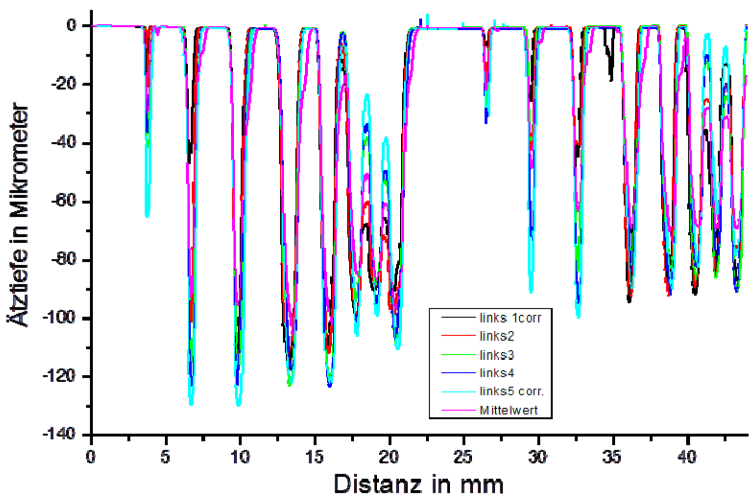


Fig. 3 Depth and width measurements of trenches etched into glass

The results obtained from the negative process could be transferred to the positive resist. By intensifying the exposure and by extending the aqueous-alkaline development time compared to previous experiments, a complete development of the positive resist layer could be achieved. Two structurable resist systems with high quality are thus available for use now.

Table 1: optimized process parameters are presented

| **Process steps** | **positive** | **negative** |
|---|---|---|
| Adhesion 4000 rpm with **AR 300-80** | | |
| Coating 1000 rpm with **SX AR-PC 5000/40** | 17 - 18 µm film thickness | |
| Coating 4000 rpm with **SX AR-PC 5000/40** | 9 - 10 µm Schichtdicke film thickness | |
| Softbake | 60 °C, 30 min., convection oven | |
| Coating 4000 rpm with **AR-P 3250/ AR-N 4400-10** | 5.5 - 6 µm film thickness | |
| Softbake | 60 °C, 45 min., convetion oven | |
| Exposure | 1.700 mJ/cm² | 2.000 mJ/cm² |
| Softbake | - | 60 °C, 60 min., Ofen |
| Development **AR-P 3250** with **AR 300-26** (1:1 dilution) | 120 sec. | - |
| Development **AR-N 4400-10** with **AR 300-44** | - | 90 sec. |
| Development g **SX AR-PC 5000/40** with X AR 300-74/5<br>**Stopper:** X AR 600-60/1 | 20 – 30 sec. | |
| Removal of **AR-P 3250/ AR-N 4400-10** after HF etching with 1.) **AR 600-70** 2.) **X AR 300-74/1** | 1) 60 sec. 2) 20 – 30 sec. | |

Fig. 4 Developed mask structure based on HF stable polymer

Fig. 5 Mask architecture etched into glass

## 3. Latest research results of polymer patterning in the CiS Institute,

Report by: Dipl. Ing. Klaus-Dieter Preuß

The project "SpraySens“ with a term of two and a half years carried out in the CiS Institute for Micro Sensors and Photovoltaics GmbH was mainly aimed at the development of a spray coating procedure for polymer-based sensitive layers as an alternative for the currently used spin coating.

Basic idea and objective target of the project is the patterning of sensitive polymer layers via a shadow mask using spray coating. In this procedure, the shadow mask functions as "data carrier" for the patterning, similar to the function of the chrome mask in photolithographic patterning processes. Due to the elimination of an entire photolithographic level, considerable rationalization effects are achieved.

The polymers which were developed and tested within the scope of this project were exclusively produced on the basis of chemically harmless raw materials (safer components). In order to accomplish this wide range of tasks, a highly professional and efficient cooperation with sustained success developed between the project partners IDM Institute of Thin Film Technology and Microsensorics e.V. and Allresist GmbH.

The polymer coating with spray coating techniques was developed and assessed in comparison with the spin coating procedure. On the example of HSFK05, a monolithically integrated hybrid stray field condenser, the process integration of the spray coating procedure with moisture-sensitive polymer (SX AR-P 5000/80.11) in a CMOS-compatible process was confirmed.

This polymer was developed and produced by the IDM as well as modified for the specific applications by the Allresist GmbH within the frame of this project. In the context of the work concerning the spray coating of sensitive layers now a stage of development is reached which allows a process integration into a CMOS-compatible process. Thus, an essential foundation is laid to allow the production of new application-specific sensors in the CiS as well as to offer specific services in this field, possibly also as backend process.

With these project results, particularly the technologic platform for polymer patterning of wafers and modules in the CiS was expanded (e.g. singulated chips in the circuit board panel of the AVT-process). New interfaces were developed which allow a direct polymer patterning both in wafer composites and for modules after a wafer processing without photolithographic patterning.

The results of the project work were summarized in the technology module "Polymer Patterning“ and are available now for the development of new fields of application by generating joint application projects between the CiS and potential users.

For interested customers and potential users, the opportunity for new cooperations now open up, in particular for small- and medium-sized enterprises (SMEs).

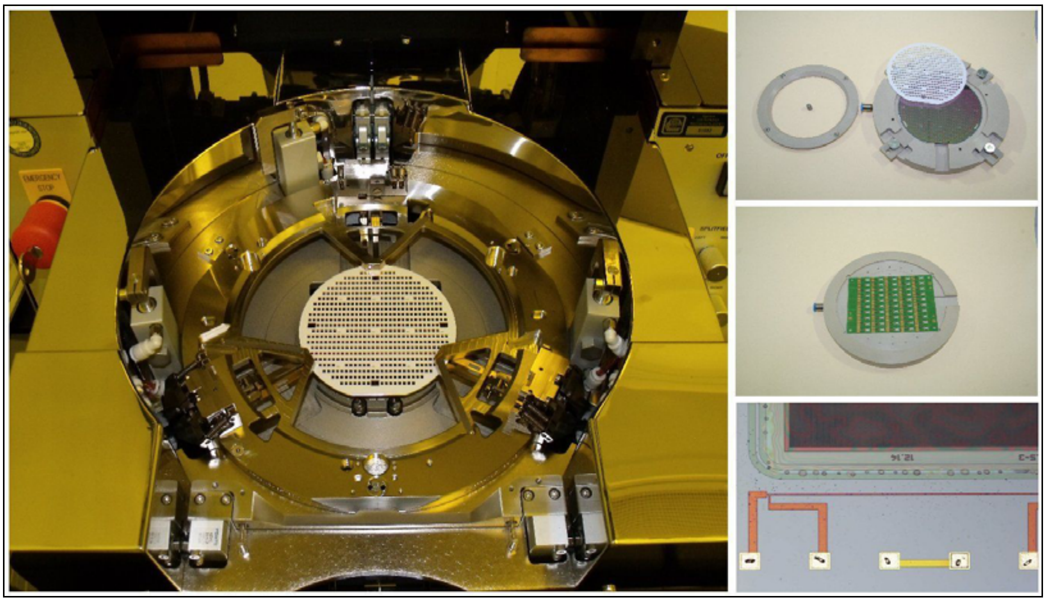

Fig. 6 shows partial results of our project work, in particular the application of ceramic shadow masks for polymer patterning using the mask aligner MA/BA6 for adjustment- and calibration processes.

## 4. Our new developments – first results

### 4.1. Positive polyimide resist for e-beam lithography

First trials with our SX AR-P 5000/82.7 using electron beam lithography showed that this resist can easily be patterned. Therefore, the possibility is now provided to generate nanostructures which are thermally stable up to 350 °C. The processing of our polyimide resist is simple. This resist requires no bake step after coating (curing process) and can be developed with an aqueous-alkaline procedure.

### 4.2. Negative polyimide photoresist

As an alternative to our positive polyimide resist, a negative resist was developed which is equally suitable to generate high-temperature resistant structures.

In this case, the developer is not aqueous-alkaline, but composed of MIBK. We would strongly recommend the polyimide negative resist for those users who utilize moisture-sensitive substrates. In the near future, experiments will start to pattern the negative resist also with electron beam lithography.

### 4.3. Semi-conductive e-beam resists

In cooperation with the IAP in Golm and based on the results of the meanwhile completed OLED project, in principle semi-conductive polymers are produced and their suitability as photo- and e-beam resist is assessed. The evidence of cross-linking and the subsequent development of structures was already provided.

### 4.4. Silylation of photoresist structures for high resistance

A subsequent silylation of photoresist films or structures leads to interesting results. Photoresists especially produced for this purpose were treated after patterning with HMDS at a temperature of 110 °C, resulting in a very high resistance to solvents and alkaline solutions. The silylation reaction can also be carried out in the liquid phase, but with reduced effectiveness as compared to gas phase silylation.

We hope to have offered a few interesting ideas and suggestions for you and strongly encouraged all our interested customers to communicate all your desires, requests and comments already at an early stage.

Our next issue of the AR NEWS will again be presented in April 2012.

Successful times until then!

Strausberg, October 10, 2011

Matthias & Brigitte Schirmer

Team of Allresist