

# AR NEWS

20<sup>th</sup> Issue, April 2010

**Allresist GmbH**

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Registration-No. 12 100 15718 TMS

Welcome to the 20th anniversary issue of the AR NEWS. We would like to inform you again about the further development of the Allresist and our current research projects:

## **1. Resist manufacturer continuing on the way to business excellence**

### **1.1 Allresist is one of Germany's customer champions 2010**

It is a great honour and a pleasure for us to inform you that **on May 3, 2010, the Allresist took a 12<sup>th</sup> place in the Germany-wide competition "Customer champions 2010"**. More than 300 companies participated in this competition, 50 of which were honoured. We reached one of the leading positions and received the desired label as one of "Germany's customer champions 2010".

Companies which are committed to become a customer champion can compete with the best companies across all business segments, thereby gaining valuable know-how in a benchmark report to improve their customer relationship management even further.

In the category of companies with less than 50 employees, we even placed third! This is an excellent result for a manufacturing company in this service-oriented competition. Of 50 companies assessed, only 9 received an award like this.

Excerpt from the certificate's laudation: "This award stands for an excellent customer rela-

tionship management and a high emotional customer loyalty. For this company, the customer is in the focus of all entrepreneurial activities."

**We would like to thank all our customers who were questioned within the framework of this competition. The majority of our customers obviously had a very positive opinion about us. This award carries an obligation for us to improve our service even further.**



Allresist is awarded the label of "Germany's customer champions 2010"

## 1.2 Managing directors of the Allresist en route as ambassador of excellence

We are very pleased that our efforts with respect to a sustainable development of our enterprise based upon the EFQM Excellence Model (European Foundation for Quality Management) has been widely acknowledged in the past years. For us, it is a pleasant commitment now to encourage and improve the concept of quality in Germany. Both managing directors, Brigitte and Matthias Schirmer, as well as their daughter, will participate in the this year's Quality Award as assessors. Beyond a joint membership in the Association for Quality Promotion Brandenburg e.V. (VQB) and the Ludwig-Erhard-Award Initiative (ILEP), Brigitte Schirmer is also member of the project advisory board of the VQB, while Matthias Schirmer is involved in the advisory committee of the iq Brandenburg. Here, the main concern is to propagate the idea of quality awards in general. This contest which was initiated by the Chamber of Industry and Commerce (IHK) intends to motivate particularly smaller companies to address and include the concept of quality issues.

But we can also offer to an interested audience comprehensive experiences with respect to business excellence, which we gained in various participations in or the organisation of quality-workshops and –events. When the Minister for Economics, Ralf Christoffers, illustrated the various activities of the European Week in Brandenburg (May 3 to 9, 2010) at a press conference on April 21, 2010, he was supported by Matthias Schirmer with a report of the promising results of EFRE-funding (European Funds for Regional Development) and the importance to disseminate the quality concept in Germany.

☞ We will gladly provide more detailed information concerning the EFQM model. Don't hesitate to ask us!

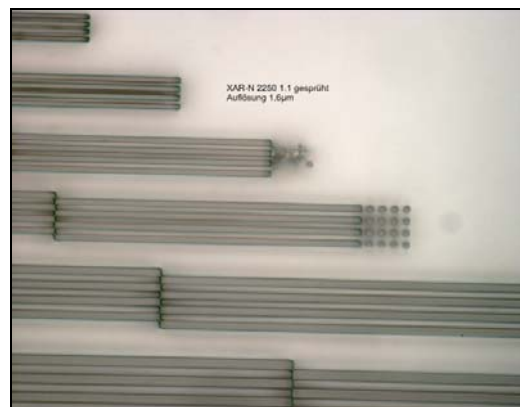
## 2. Spray photoresist series for a large variety of topologies

Spray resists available to date are intended for extremely structured topologies, which means that even vertical silicon trenches can be covered with resist. This excellent feature however has its price: the resist surface is very rough, so that refractory layer thickness measurements are not possible without further treatment. In addition, a strong tendency for “droplet formation” can be observed. Resist films are drying so quickly that a major part of the drops has already dried before the drops reach the substrate. Consequently, small beads occur on the surface which impede many of the successive processes. If acetone is used which is highly volatile, further problems may arise since gasses develop within the resist line of the spray coater, thus hampering an even coating procedure.

This motivated us to optimise our spray resists even further. Lutz Nüske of the Fraunhofer IPMS, Dresden, performed several test runs with modified samples using the Süss spray coater “Gamma AltaSpray“. These experiments were carried out with etched silicon wafers with slope angles of 54° (depth 300 - 400 µm). The solvent composition was successively changed towards a less volatile solvent, and acetone was omitted completely. This resulted in substantially improved surfaces, which also allowed for a refractory layer thickness measurement. The tendency to form beads was significantly reduced. Nevertheless, a complete and sufficient covering of wafer topologies was achieved. At film thickness values of 3 – 5 µm, a resolution of 1 – 2 µm could be obtained.



Good resist surface with complete covering of all topologies – positive resist SX AR-P 1250/25.2



Resolution test with negative-tone resist SX AR-N 2250/1.1  
Film thickness 5 µm, high sensitivity

<b>Süss spray coater “Gamma AltaSpray“</b>	<b>Positive resist SX AR-P 1250/25.2</b>	<b>Negative resist SX AR-N 2250/1.1</b>
Resist flow rate	25 drops/min	40 drops/min
Arm speed	75 mm/s	90 mm/s
N <sub>2</sub> - pressure	0.9 bar	0.9 bar
Spray height	20 mm	20 mm
Exposure	Nikon stepper B14, i-line, NA = 0.65	Nikon stepper B14, i-line, NA = 0.65
Sensitivity (film thickness)	200 mJ/cm <sup>2</sup> (5 µm)	70 mJ/cm <sup>2</sup> (5 µm)
Development	AR 300-44, 4 x 60 s puddle	AR 300-44, 4 x 60 s puddle
Minimum resolution	1.2 µm	1.4 µm

Our investigations will be continued. We will soon present a series of positive- and negative-tone resists for various topologies and for plane substrates. For the following applications, we currently design new resists:

Vertical side walls: AR-P 1210 (positive-tone) ; AR-N 2210 (negative-tone)

Etching of 54° slopes: AR-P 1220 (positive-tone) ; AR-N 2220 (negative-tone)

Even wafers: AR-P 1230 (positive-one) ; AR-N 2230 (negative-tone)

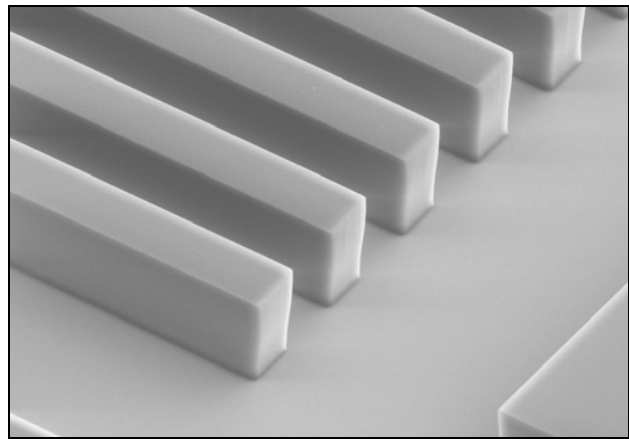
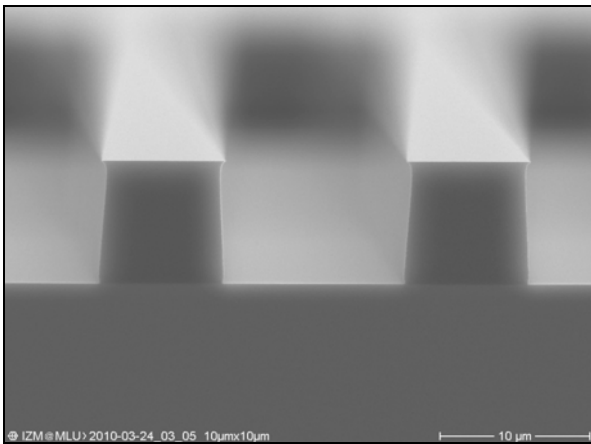
Due to the specific properties of the respective drying processes of our products, these resists can easily be adopted to even highly specific requirements of other spray coating devices provided by other manufacturers.

☞ To all our customers and interested persons, we offer to participate in the testing process of our new spray resists. During this optimisation phase, we will even more be able to individually respond to special requests or particular problems.

### **3. Optimisation of thick resists AR-P 3220**

Due to the continuous development in micro system technologies, also requirements for photoresists are constantly increasing. We therefore successively optimise our thick resists, aiming at a very high performance of resist structures (vertical slopes, in particular for galvanic processes), a high transparency of films at the exposure wavelength (for films with high thickness values), and a good suitability for galvanic baths (no “bleeding”). This project is supported by the Institute of Physics, Martin-Luther-University of Halle, led by Prof. Dr. Georg Schmidt.

Building on our many years of experience, well-proven resist compositions were modified with new raw materials. First results demonstrate a substantial improvement. Resist SX AR-P 3220/20 (see figure below) has a very high structural quality. The transparency of the resist film, which is enhanced by an addition of further components, is expected to ensure a good performance also at higher film thickness values. This project started only recently, and again we would like to invite you to participate and to contribute with your own ideas and particular demands.



7-µm-structures with SX AR-P 3220/20 at a film thickness of 10 µm, developer AR 300-26

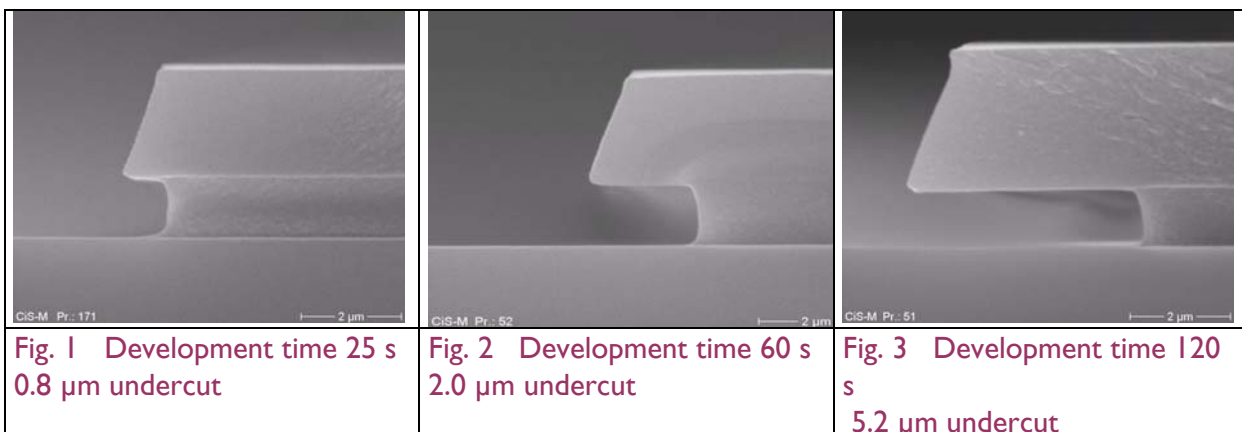
#### 4. Development of a single-layer lift-off system based on AR-N 4450

Report: Dipl. Ing. Klaus-Dieter Preuß

With many of our long-time customers, we jointly develop new products. We now take the opportunity to present Mr. Preuß from the CiS Institute for Micro Sensors and Photovoltaics GmbH, who assessed various lift-off techniques in cooperation with the Allresist, a close cooperation, which already persists since 1993.

“Within the frame of a longtime cooperation between the Allresist GmbH and the CiS Institute for Micro Sensors and Photovoltaics GmbH, we jointly developed in 2005 a two-layer system for highly demanding lift-off techniques.

As bottom layer, polymer AR-P 5460 was spin-coated and dried. As top layer, the standard positive-tone resist AR-P 3540-MIF was used. The development was performed with the standard developer AR 300-475. Due to the sensitometric calibration of AR-P 5460 with AR-P 3540-MIF, the “undercut“ of resist edges, which is dependent on the respective duration of the development step, can be predefined by using a specific resolution speed (Fig. 1 – 3).



However, these different lift-off geometries cannot be generated entirely independent of other parameters. For a desired line width of 2.0 µm and a development time of 25 s, which consequently results in an undercut of 0.8 µm per edge, a foot of only 0.4 µm would remain – which in most cases leads to a collapse of the structure.

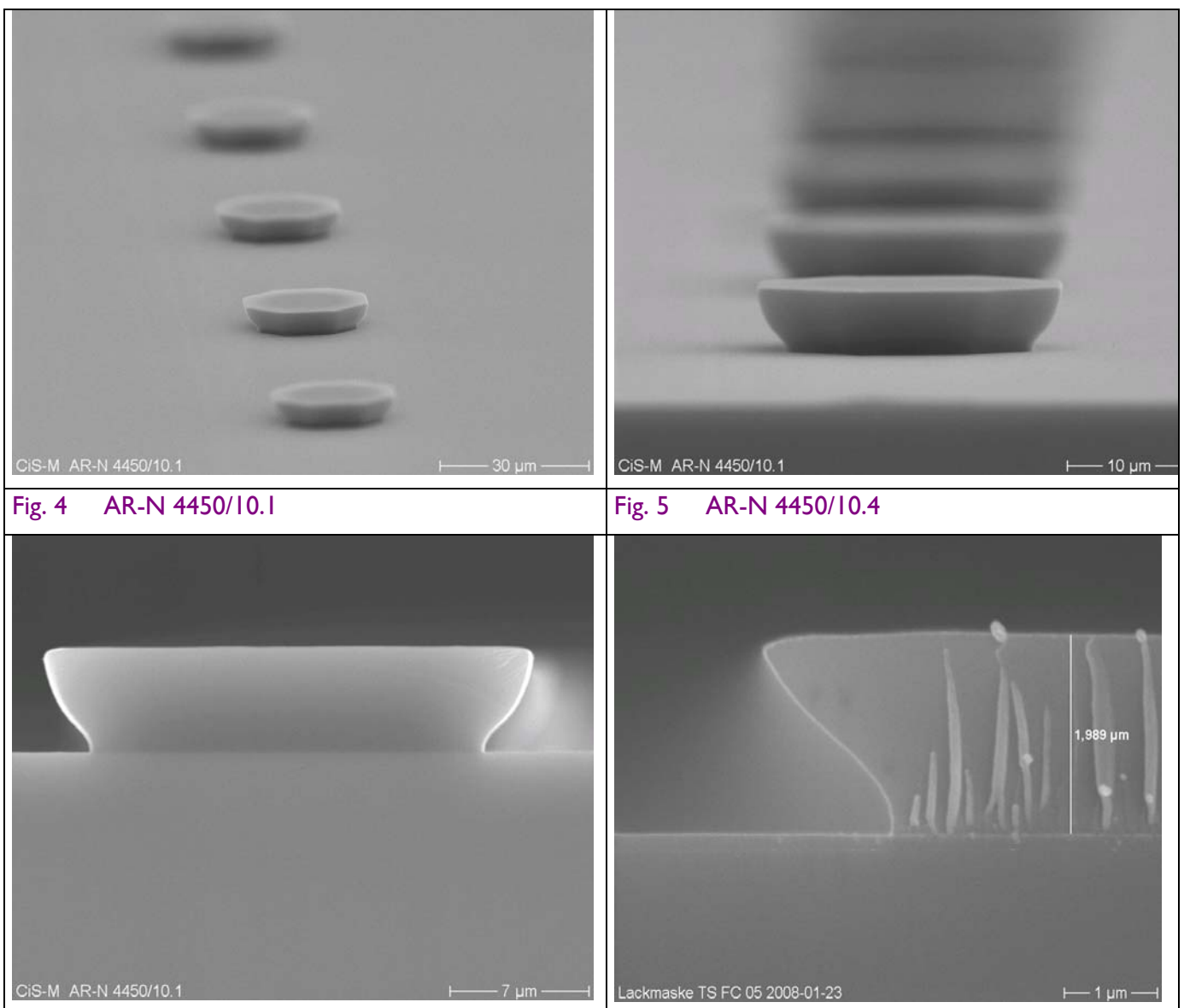
If factors such as an easy and cost-efficient production technology are taken into consideration for the production of lift masks, automatically single-layer lift-off systems come into question. In the past however, these kinds of single-layer lift-off systems with accordant undercut edges were **not** available.

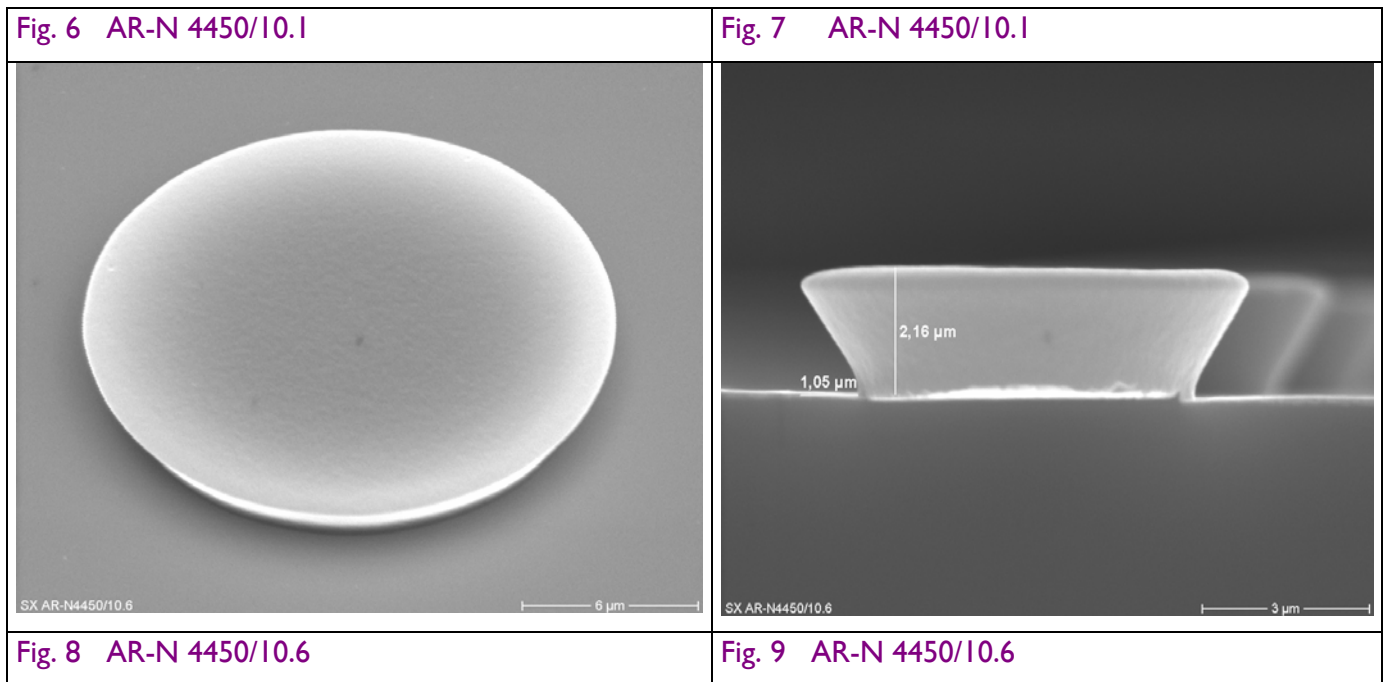
For various structuring problems in micro system technology, a single-layer lift-off system with a minimum resolution of more than 5.0  $\mu\text{m}$  was looked for.

Since first attempts with a modification of our standard positive-tone resist AR-P 3540-MIF for such applications were unfortunately not successful, various other resist samples of the Allresist GmbH were assessed between September 2008 and February 2009 with respect to their adequacy for a use as single-layer lift-off system.

In addition to the foto-chemical parameter field (FCPF), resist edges were characterised by REM imaging.

As result, a film thickness of approx. 2.0  $\mu\text{m}$  could be achieved with these resist samples at a rotational speed of 4000 rpm. Optimising this process within the frame of the FCPF, typical undercut resist edges as shown in Fig. 4 - 9 were obtained.





The lift-off process can be performed with acetone at room temperature within a few seconds, depending on the film system which is to be lifted. Thin metal and noble metal films with a thickness of less than 30 nm can be lifted within 20 seconds. The technology as described here can be offered by the CiS Institute for Micro Sensors and Photovoltaics GmbH as service for interested customers.”

Presenting our most recent new developments we hope to have encouraged you and look forward to a constructive and creative cooperation in the future. Our next issue of the AR NEWS will again be presented in October 2010.

Successful times until then!

Strausberg, Mai 04, 2010

Matthias & Brigitte Schirmer

Team of Allresist