AR NEWS

18th Issue

Allresist GmbH

Content:

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1. Resist manufacturer on the way to excellence

1.1 Allresist applies for the Ludwig Erhard price

Valued reader of the AR NEWS, we would like to inform you once again about the further development of the Allresist and our research projects as well as our progress on the way to a business of excellence:
Encouraged by the Quality Award Berlin/Brandenburg received in 2008, we applied for the first time for the Ludwig Erhard price this year. Being well aware of the fact that our current state of excellence is not yet sufficiently high to win this top level award, we nevertheless hope to gain valuable suggestions for our continuous further development from the process of application and the assessor feedback. Our sub-goal for 2009 is to reach the level of "Recognised for Excellence", which will support our main goal to become "Best German Niche Player in Resist Production". Customers, partners, and staff members will benefit from the potential for improvement identified in this process. In our next AR NEWS (October 2009), we will inform you about the result of our application.

The economic crisis has meanwhile reached many fields of microelectronics and also concerns some of our customers, who are affected by the implications of lower contract volumes and temporary short-time work in a few cases.
For these challenging times, we offer our customers to see this crisis also as chance and to use these idle working hours for an improvement of resist technologies or the implementation of new procedures. We would like to strongly support you in this process with our know-how and our new resists.

1.2 New research project for e-beam lithography, OLEDs, and solar cells

The German Government and also the federal state of Brandenburg fortunately still continue with their efforts to support innovative medium-sized enterprises (e.g. ZIM, promotion of FuE projects). Allresist can thus continue with its research activities on a high level. In addition to our currently ongoing successful project "Mask resists" (see 17th issue of the AR NEWS), three new projects were applied for, two of which are already close to approval. Below, we present the main tasks and goals of our applications, encouraging your input with respect to own wishes or own future demands. We would even more appreciate your trustful cooperation in these projects.

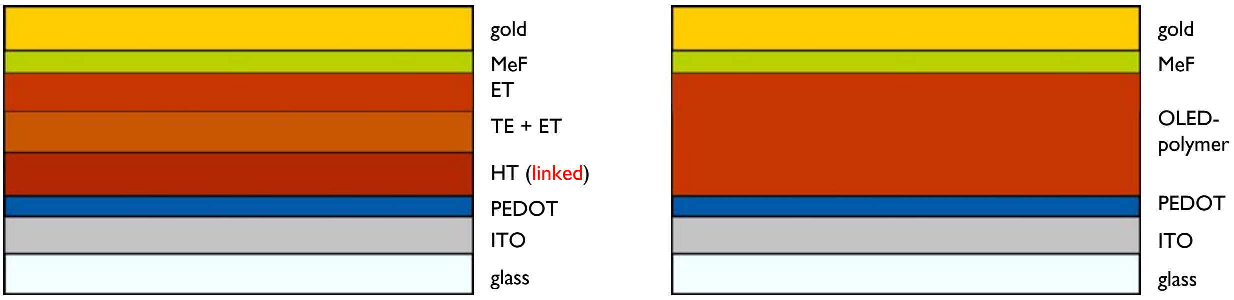
2. Test of alternative cross linking procedures for epoxy-styrene and transfer of results to OLED-, OFET- and micropatterning applications

In cooperation with the Fraunhofer Institute for Applied Polymer Research in Golm, we will develop organic light-emitting diodes or organic field effect transistors (OFET) with improved features. Aim of this project is to realise qualitatively improved and technically easy-to-produce structural components by combining modern resist technologies with the development of new, efficient polymeric materials for organic electronics. Within the frame of this project, particularly alternative cross-linking procedures well known in resist technologies will be adapted to applications with relevant polymeric materials as mentioned above.

In general, multilayer OLEDs show higher performance and significantly improved durability as compared to single-layer OLEDs, which is due to the separation of charge transfer and emission. For the build-up of solvent-processed multilayer OLEDs however, deposition of the subsequent film by spin coating causes a partial dissolution of the previous film, thus resulting in a mixture of both films. To solve this problem, cross-linkable films are utilised which can each be cross-linked separately and are basically insoluble during the following deposition step (see Fig. 1). Here, improved features for the production of OLEDs shall be realised with respect to completeness of the cross-linking reaction, shorter process times, and lower cross-linking temperatures. Furthermore, cross-linking procedures are optimised for specific applications in microelectronics. In photo lithography and particularly in electron beam lithography, a great interest exists for both conductive as well as isolating films or structures, respectively.

Figure 1

Film composition of a conventional OLED (right), on the left a composition with three different polymers for the “hole” (HT) and electron transport (ET), and for emission (TE)

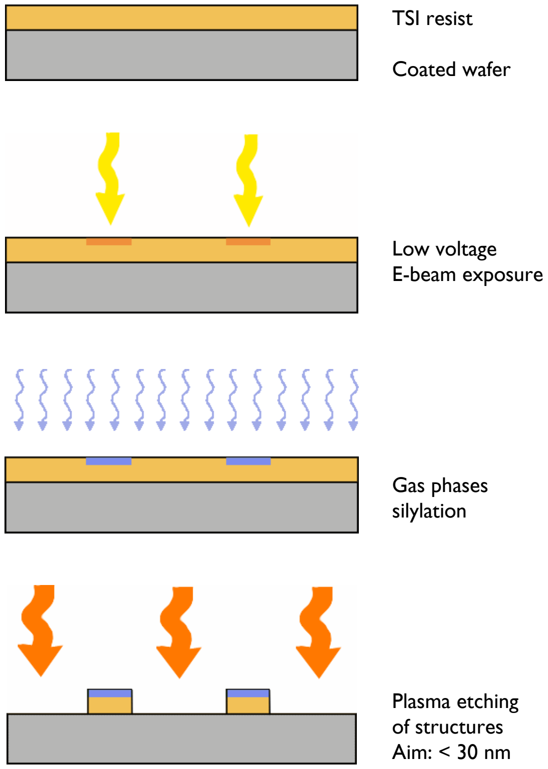


We highly appreciate any expression of interest, suggestions, and proposals concerning this project and offer to support us in this project already at an early stage. The project will start in the middle of 2009 and continue until the end of 2010.

3. Top surface imaging resists for low voltage electron beam lithography (T-SElekt) for resolutions < 30 nm

This project is a cooperation of the companies Sentech Instruments, Berlin, Raith, Dortmund, and Allresist with the Martin-Luther University of Halle. Aim of the project is to develop optimised top surface imaging (TSI) resists for low-voltage electron beam lithography, to assess the applicability of these resists for silica technologies, and to simplify their use. For TSI resists, the film is modified by exposure in such a way that a selective chemical near-surface hardening of exposed areas is possible. The following development step is performed by etching in an oxygen plasma (see Fig. 2) .

Figure 2 Top surface imaging – the principle:



The use of such resists in electron beam lithography will allow to operate at extremely low acceleration voltages. Under these conditions, standard resists cannot be exposed completely throughout the entire layer, due to the low penetration depth of electrons. Applying TSI technologies, the required penetration depth can be reduced, thereby increasing the effectively usable film thickness dramatically. Since low-voltage lithography requires significantly lower exposure doses than commonly used processes with acceleration voltages of 25 kV or more, a further step towards an efficient employment of electron beam lithography in production processes is achieved here. Within the frame of this project, thus a new resist line is created which increases the chances for electron beam lithographic applications in production processes and may consequently also extend the market for these resists.

As main tasks, systematically first multilayer resists and then single-layer resists for TSI will be developed and tested. The possibility to optimise these TSI resists is greatly enhanced if different resist mechanisms are utilised. Chemically enhanced resists are very sensitive, but tend toward diffusion. On the other hand, films which are based on radical reactions are less sensitive but basically diffusion-free. By mixing both resist types into one hybrid film, an optimal combination of the respective positive features can be searched for. Similarly, a possible diffusion during the silylation step can be eliminated if the resist is silylated over the entire surface prior to exposure and still remains structurable, or if silica-based polymers are used for the e-beam resist which do not require a gas phase silylation step.

The final target parameters are listed in the following enumeration. Particularly remarkable in this context is the desired structural resolution of < 30 nm, which, from today’s perspective, could not be achieved with any industrially applicable e-beam resist so far.

1) Two-layer TSI resist for low exposure doses, resolution < 30 nm, compatible with mainstream silica technologies
2) Single-layer TSI resist for low exposure doses, resolution < 30 nm, compatible with mainstream silica technologies
3) Feasibility study for ultra-fast writing at high beam currents and low dosage
4) Studies concerning the applicability of resists in various industrial test procedures

5) Feasibility study concerning the proximity correction required. For TSI, the inhomogeneous structure of the resist, changes occurring during dry development, and subsequent anisotropic dry etch processes have to be taken into consideration. Even though it may appear unusual in electron beam lithography, this is already routinely assessed by complete process simulation in optical lithography which serves in this case as generally accepted guideline. A future industrial implementation should therefore cause no problems.

We think that this is an extremely exciting task and would be pleased if your are interested in a cooperation.

4. Etch resists for solar cell production

In our last AR NEWS (17th issue), we described glass etching procedures using a two-layer system. First applications in microelectronics demonstrated the high potential of this new development. We were however also looking for further industrial applications.

Solar cell production and thus also photovoltaics both belong to the rapidly developing branches of industry. Particularly in Brandenburg this sector of industry, which is currently the main focus of development in the eastern part of Germany, is paid much attention to. For photo resist producers however, a cooperation in this branch of industry was so far basically impossible. The patterning steps essential for the production of solar cells were exclusively realised by screen printing, requiring pastes instead of resists. Sizes of structures lie within the millimetre range, in a few cases 0.05 mm (50 µm) are demanded. This is a range which can just about be achieved with modern screen printing techniques, so that the comparatively time-consuming and expensive photolithography is no longer needed. After market research, we now see a good chance to eventually enter the solar cell market. For this purpose, the good etching properties of HF-stable resists have to be transferred into a film which is suitable for screen printing. Utilising the etch-resistant resist materials of the PRO INNO II project, this project is now aimed at designing a screen printing film which is suitable for the production of solar cells.

Etching pastes are problematic, since pastes are not entirely removed from etched nitride layers after the process. Laser abrasion which can be used alternatively removes the nitride, but also damages the silicon underneath. Our two-layer system is therefore predestined to eliminate these disadvantages. The technology of solar cell production is described in detail in [1] and [2]. We furthermore offer to answer your questions concerning relevant aspects of resists in this regard.

[1] **Minority carrier lifetime monitoring in a buried contact solar cell process using MC-SI**
B. Raabe, K. Peter, E. Enabakk, G. Hahn
Universität Konstanz, Physikalisches Institut, Elkem Solar AS, Fiskaaveien, Norwegen

[2] **Two diffusion step selective emitter: comparison of mask opening by laser or etching paste**
F. Book, B. Raabe, G. Hahn
Universität Konstanz, Physikalisches Institut

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

Our next issue of the AR NEWS will again be presented in October 2009.

Successful times until then!

Strausberg, 28.04.2008

Matthias & Brigitte Schirmer

Allresist Team