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To Members of the Press

Nippon Soda Co., Ltd.
Kansai University

Nippon Soda Co., Ltd. and Kansai University Jointly Develop Underlayer Film Material to Enhance the Sensitivity of EUV Resists

- Sensitization Effect of at Least 20% Confirmed in Initial Evaluation -

Nippon Soda Co., Ltd. (Head Office: Chiyoda-ku, Tokyo; President: Eiji Aga; hereinafter "Nippon Soda") and Kansai University, a school corporation (Location: Suita, Osaka; President: Tomoyuki Takahashi; hereinafter "Kansai University"), have jointly developed a new underlayer film material that enhances the sensitivity of EUV (extreme ultraviolet) resists, the photoresists used to manufacture advanced semiconductors.

The developed material is a polymer placed between the EUV resist and the semiconductor substrate. It is designed to promote the chemical reaction of the resist during EUV exposure. In initial evaluations using a positive-tone chemically amplified resist (CAR), the resist reacted at a lower EUV exposure dose than without the material. Using the resist thickness loss as the indicator, the companies confirmed that the EUV exposure dose required was reduced by at least 20%, indicating a sensitization effect. A similar sensitization effect was also observed with a negative-tone CAR, a technology used to form thick films. These results indicate that the material may be effective in improving the sensitivity of EUV resists. The two companies will optimize the composition and structure of the material and advance toward its adoption in next-generation semiconductor manufacturing processes.



Hiroki Hashimoto, General Manager, Business Development Department, Chemical Business Division, Nippon Soda (left), and Professor Hiroto Kudo, Faculty of Chemistry, Materials and Bioengineering, Kansai University (right).
Photographed on November 5, 2026, at Professor Kudo's personal laboratory at Kansai University.

Background of Development

EUV lithography is an essential technology for forming fine circuit patterns of several nanometers to several tens of nanometers on leading-edge semiconductors. Advanced semiconductors produced with this technology are used in a wide range of fields, including data centers that support generative AI and high-speed communications. EUV has a wavelength of 13.5 nm, a short wavelength compared with ArF light (193 nm) and KrF light (248 nm), which enables finer processing.

EUV exposure faces two challenges. The first is power consumption. EUV exposure tools consume far more power than other exposure methods, requiring several times the power or more of conventional exposure methods. * Improving the efficiency of the exposure process is therefore increasingly necessary to reduce energy use in semiconductor manufacturing.

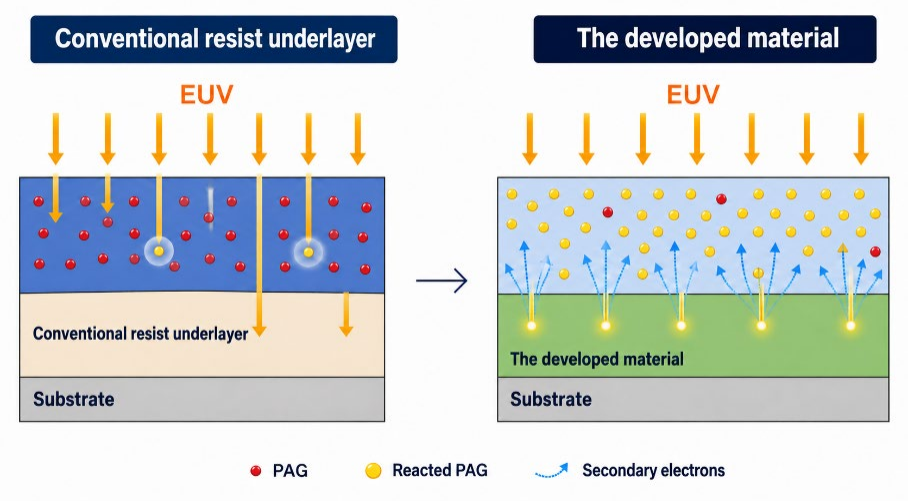
The second is that EUV exposure involves a relatively low number of photons per unit of exposure energy.Because short-wavelength light is readily absorbed by air and materials, the amount of light that reaches the resist is limited. Materials that use EUV efficiently and sensitize the resist to expose it at a lower dose are therefore needed.

Addressing these challenges also contributes to SDG 7, "Affordable and Clean Energy," and the developed material is expected to contribute to this goal.

*Source: ASML, 2025 Annual Report based on IFRS https://investor.asml.com/annual-reports/2025/downloads

Overview of the Developed Material

The developed material is a polymer with an EUV sensitizing function, intended for use as an underlayer film beneath the EUV resist. Conventional underlayer films are used to improve the coatability of the resist, its adhesion to the resist and the semiconductor substrate, and antireflection. In addition to these functions, the developed material absorbs EUV and generates secondary electrons. During EUV exposure, EUV that passes through the resist layer is absorbed by the underlayer film. The secondary electrons generated then act on the photoacid generator (PAG) and other components in the resist, promoting the resist's chemical reaction and improving sensitivity.

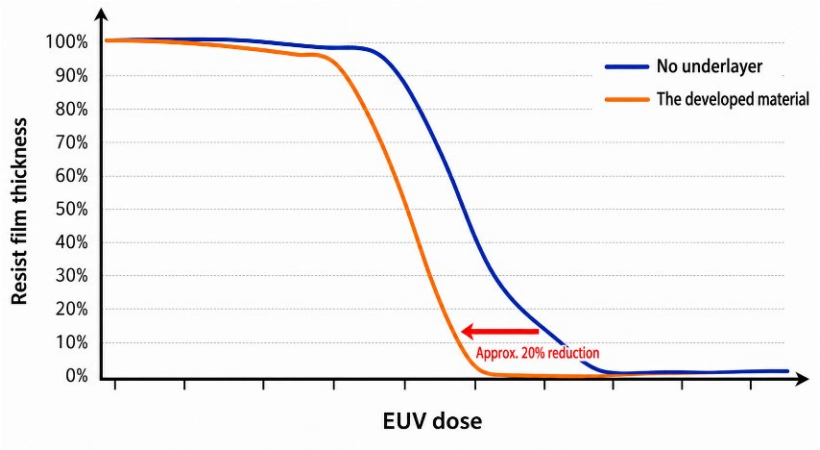


[Figure: Difference between a conventional resist underlayer and the developed material]

Evaluation Results

As an example, the material was combined with a positive-tone CAR and evaluated under EUV exposure. When the developed material was used as the underlayer film, the resist reaction proceeded at a lower EUV exposure dose than without an underlayer film. In this initial evaluation, the resist thickness loss after development was used as the indicator. When the developed material was used, the EUV exposure dose needed to obtain the same degree of thickness loss was reduced by at least 20% compared with the case without an underlayer film. This indicates that the same level of resist reaction occurred with less exposure, demonstrating the sensitizing effect of the developed material on EUV resists. In evaluations with a negative-tone CAR, the developed material also tended to promote the resist reaction compared with no underlayer film.

These results are based on initial evaluations. The companies will verify the relationships among resist type, resist film thickness, underlayer film thickness, exposure conditions, and development conditions, and will continue to improve the material and confirm its effectiveness.



[Figure: Confirmation of the sensitizing effect with a positive-tone CAR]

Future Plans

The two companies plan to study the optimization of the material's composition and structure; its fine pattern formation performance and applicability to semiconductor manufacturing processes; and the mass-production capability, quality stability, and supply system needed for practical use.

Comments from the Companies

Hiroki Hashimoto, General Manager, Business Development Department, Chemical Business Division, Nippon Soda

"Reaching this point required clearing many high hurdles, and our persistent research with Professor Hiroto Kudo of Kansai University has finally begun to bear fruit. Semiconductors are often called the "rice of industry," and they have become indispensable to our daily lives. Their advancement, represented by generative AI and high-capacity, high-speed communications, will enrich people's lives. This sensitization-based EUV exposure approach has the potential to dramatically transform semiconductor exposure systems, and we will continue development toward social implementation."

Professor Hiroto Kudo, Faculty of Chemistry, Materials and Bioengineering, Kansai University

"This was not research aimed at an expected result. It is a result that was born when several unforeseen circumstances came together. At first glance, the result is neither complex nor difficult, and one might even regard it as a naturally derived outcome. Yet it is true that some aspects of the underlying mechanism have not yet been fully elucidated academically. I believe this achievement embodies the true joy of research, born from meticulous accumulated work combined with various coincidences."

Glossary (For Reference)

EUV (Extreme Ultraviolet): Extreme ultraviolet. Semiconductor lithography uses EUV light with a wavelength of 13.5 nm.

EUV resist: A photosensitive material used to form fine patterns on a semiconductor substrate using EUV.

Underlayer film: A thin film formed between the resist and the semiconductor substrate. It improves the adhesion and coatability of the resist and suppresses reflection during exposure.

Secondary electrons: Electrons generated when a material absorbs high-energy light such as EUV. They can promote chemical reactions in the resist.

Positive-tone: A type of resist in which the exposed areas decompose and become soluble in the developer, forming the pattern.

CAR (Chemically Amplified Resist): A resist in which the acid generated by a photoacid generator on exposure amplifies the chemical reaction.

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