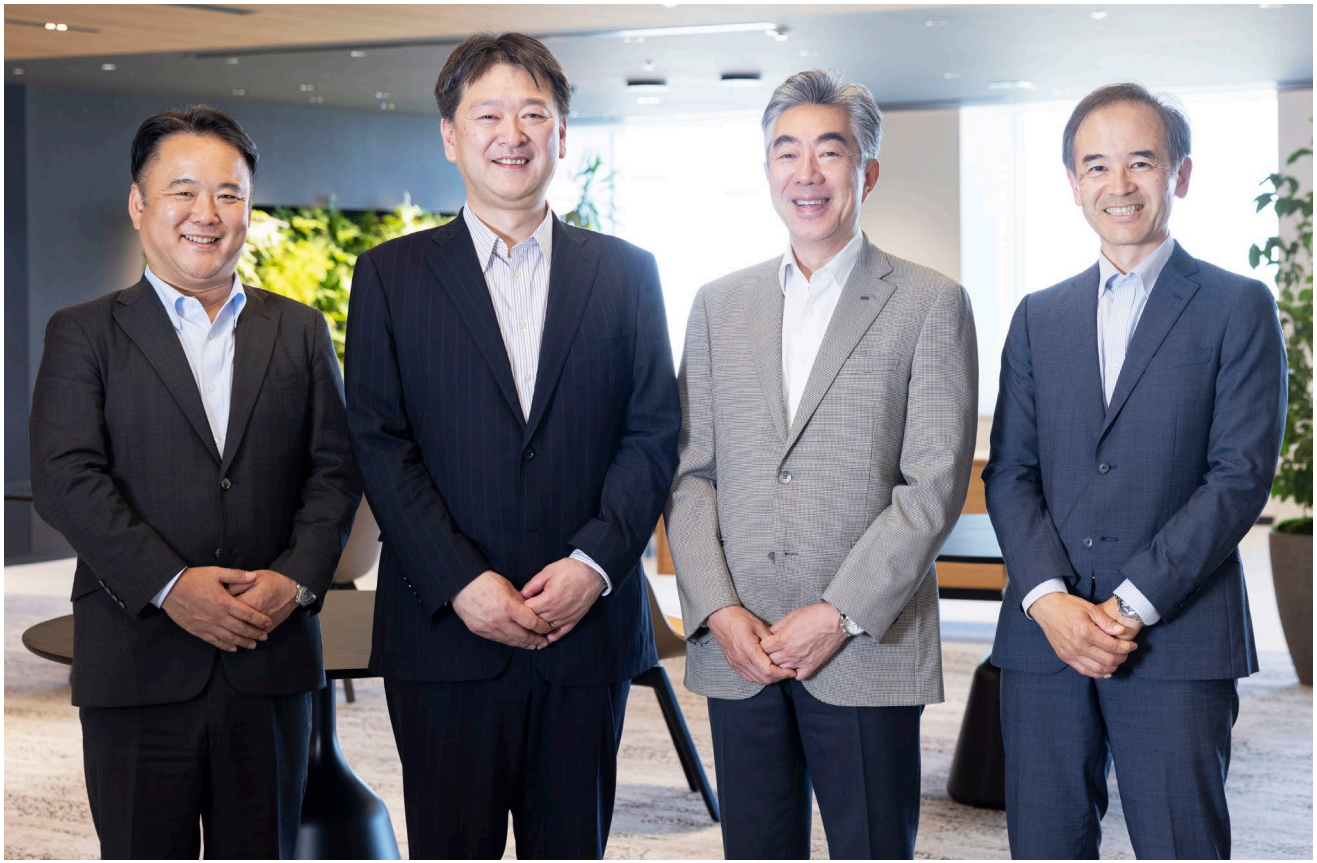
IBM × JSR Roundtable Discussion

Building a Foundation for Next-Generation Manufacturing and Innovation through Collaboration



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Engineers' Pride and Fulfillment: Building the Future Together

How did the collaboration between JSR and IBM begin?

Nagai (JSR) Our partnership with IBM began in 2000 with the joint development of ArF resists. Since then, through additional efforts, we have created critical IP, including patents and know-how, which became the foundation of two of JSR's core products, ArF and EUV resists.

In 2016, we started joint research on artificial intelligence (AI). Through participation in IBM's Research Frontiers Institute*, an IT fundamental research consortium, we were also able to lay the groundwork for materials informatics, which improves the efficiency of materials development.

At the time, I was astonished by the vast possibilities of AI and inspired by the glimpse it offered of a transformed future. The technologies we gained then are now directly and indirectly applied in the development of photoresists.

* An open research consortium established in 2016 that advances next-generation computing technologies through industry-academia collaboration. Focusing on neuromorphic devices, quantum computers, and bio-related devices, it promotes R&D across 10 themes in partnership with a wide range of industry players to drive innovation in computing technologies.

Morimoto (IBM) Photoresists are essential for semiconductor scaling and they must constantly evolve in response to technological advances. For IBM, the

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opportunity to partner with JSR and conduct research on this evolution is a major advantage.

IBM is not primarily a chemical company, but we do create new technologies by working closely with various materials and equipment manufacturers in the semiconductor ecosystem. Among them, JSR is one of our most important partners.

In collaborative research, bringing together people from diverse companies, specialties, cultures, and ways of thinking tends to produce more valuable innovations. The fact that our partnership has lasted more than 20 years is itself proof of the value of diversity in driving innovation.

Yamamichi (IBM) I had the opportunity to work with JSR on AI research, and I really enjoyed the experience. Each JSR researcher had their own unique strengths, character, and research style. We worked as equal partners, sometimes challenging each other with tough opinions and pushing each other forward. It was incredibly rewarding.

What do you hope to achieve in the medium to long term through this collaboration?

Nagai (JSR) The pace of change in our markets and technologies is extremely fast, and it's difficult for us to foresee the future. Generative AI and quantum computing are also evolving rapidly, which brings new challenges. That's why choosing the right partners is so critical.

Morimoto (IBM) AI systems are becoming increasingly specialized, connecting in ways that will require agent systems to manage them. Some argue humans should interact with AI systems through natural language, while others favor programming-like methods. In practice, I think a balance will be needed.

Yamamichi (IBM) I work in semiconductors, but the IBM Group as a whole is developing systems that will support social infrastructure more than 20 years from now.

In this context, JSR is an essential manufacturing partner, and their feedback as an end user of completed technologies is equally critical. I hope we can continue to work together on both manufacturing and utilization to build a safe society 10 and 20 years into the future.

Morimoto (IBM) With a collaborative relationship of 25 years so far, I believe we must continue to work hand in hand for another 20 or 30 years to build a future that no single company could establish alone. We're not just observing the future—we're helping to driving it. That makes me proud and happy as an engineer, and I hope to continue walking this path together.

Kimura (JSR) I believe the efforts we make today and tomorrow will build the foundation for the future. I'm grateful for the 25 years of collaboration between JSR and IBM, and I hope we will continue to progress together for the next 25.

AI Points the Way – Humans Bring It to Life

How are you turning the outcomes of your collaboration into business opportunities?

Kimura (JSR) In the early days of our work together, we developed photoresist materials and brought them to market as JSR's products. That continued for more than a decade, but as chemical technologies became more complex, we began to see the limits of what we could do together.

In discussions about what to do next, we came up with the idea to build a foundation for future product development while keeping an eye on the next generation. This became the Research Frontiers Institute. In the semiconductor industry, where progress is extremely rapid, I feel that we can keep pace thanks to this foundation.

Morimoto (IBM) IBM supports cliants applying AI across many industries, so we see a wide variety of use cases. Many of these cases provided valuable reference points for our collaboration with JSR and, in turn, JSR's approach—thoroughly preparing data and then demonstrating agility in solving challenges—is a model success story we share with other clients.

Kimura (JSR) We have been able to immerse ourselves so

deeply in AI because of the various use cases we saw in our joint research. It motivates us to support growing fields through materials science, and it makes us think about the "end goals" that future technologies will require.

What challenges and prospects lie ahead, especially in terms of talent development?

Morimoto (IBM) I believe AI's evolution will lead to greater automation and physical AI*. But as automation increases, there is a risk of a decline in opportunities for people to learn and maintain basic skills. Preserving human capabilities is a major challenge for the future.

Yamamichi (IBM) Even with the advancement of automation, first-hand experiences—such as using a beaker or writing code—become more valuable and actually lead to deeper understanding.
I once visited JSR's Yokkaichi plant and was shocked to see the photoresist production lines, which support the world's most advanced semiconductors. I even thought, "I'm not allowed to see this area," but the person in charge said, "Go ahead and look—it can't be replicated so easily."

JSR's strength comes from its accumulated first-hand experience and know-how, which is something that AI and material informatics alone cannot replicate. I was deeply impressed by that confidence I saw at the Yokkaichi plant, and I would like for IBM to also reach that level.

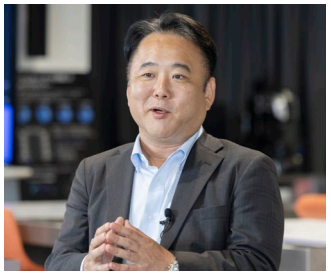
Kimura (JSR) When we think about reducing greenhouse gas emissions and electricity consumption, we tend to focus on how to make our own factories more efficient or how to purchase renewable energy. But imagine if ultra-efficient brain-inspired logic devices reduced energy use to 1/1000th. If JSR contributed materials for that, we could say we truly had an impact on society.

I hope every employee feels proud of contributing, even in small ways, to global efforts like this, while continuing to advance our technology.

Nagai (JSR) For talent, I think the right mentality is key—being open to change, being adaptable, and even being excited by change. I have experienced a great deal of change myself. I used to do only wet chemistry, making resins for resists by hand. Today, I work with AI—something I could never have imagined 20 years ago—and I am excited by its possibilities.

Morimoto (IBM) Materials and physical properties are only one aspect, but they are vital for the development of technology. Equipment and machinery are also important, and if any one aspect is missing, we cannot move forward. We hope to contribute for a long time as an important member of various communities and ecosystems.

I believe that the talent that will be sought after in the future will not only be knowledgeable about semiconductors but also well versed in digital technology and the various technologies surrounding semiconductors. We already live in an age where we cannot talk about semiconductors and materials development without mentioning AI and digital technology. Even factory management systems today are largely controlled by AI. Without understanding how such systems work and how to use them, it would be difficult to fully leverage—and further develop—one's own expertise.



We also need talent who can envision what comes next and have the insight to prepare for it. I believe those who combine digital tools with deep expertise in semiconductors and materials will hold the key to the future.

Yamamichi (IBM) Even though semiconductors, quantum, and AI are more widely recognized, they still require special expertise. Some young people might assume that it is too difficult for them but, in reality, these fields are very broad. You don't necessarily need to specialize in electronics engineering or quantum physics. By removing self-imposed barriers, you expand your possibilities.

In fact, when the semiconductor industry was first booming in Japan, people with various specialties entered the field. I feel that trend is coming back. It will become more important to not limit yourself and be willing to take on challenges beyond your field of expertise.

Kimura (JSR) In a world where AI and other technologies can analyze data and show us direction, decisiveness and the ability to act will matter more than ever. In our early days, we prepared and refined photoresists by hand. For younger generations without that kind of hands-on experience, developing their ability to make decisions will be a new challenge.

* AI systems that are connected to the physical world—such as sensors and robots—and perceive, decide, and act in real environments