Q&A at the Explanation Meeting on the Business Creation Sector

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Note:
SE = solid electrolyte
DOE = Design of Experiments, this methodology is applied to build a development facility for identifying and resolving issues in advance by verifying customer designs.

■Q&A Session

【SE】
Q.
Regarding all-solid state batteries (ASSBs), initially, we had the impression that your company was very advanced in this field. However, an increasing number of companies are starting to make efforts toward all-solid state batteries, such as the collaboration between Toyota and Idemitsu Kosan. Meanwhile, your company has been investing in a pilot plant. Could you tell us more about this situation?

A.
We are conducting appropriate discussions with those who are aiming to mass produce in 2027 as well as those who are aiming for full-fledged implementation in 2030. As development is progressing in relation to this, we do not feel as if we are lagging behind other companies. However, when seen on a global scale, I believe that we should be concerned about the fact that Chinese and Korean companies are also moving ahead in their development, and we will respond to these activities appropriately. From a global perspective, all-solid state batteries, including solid electrolytes, are advancing, which poses a threat. At this time, we are not lagging behind, and we will thoroughly implement strategies to ensure that we continue to remain frontrunners going forward.

Q.
Regarding all-solid state batteries, I felt that they could be developed by China or Korea. I wondered whether it could be done simply because perhaps there are recipes, so could you tell us your thoughts on this?

A.
Although I am not able to unambiguously declare that these can be developed easily, I can say, for example, that we have already surpassed liquid-based lithium batteries. Chinese companies have extremely powerful manufacturing technologies, so I believe we should be vigilant of this threat because, if they put their minds to it, they will probably succeed in development. However, I am not sure whether they will be able to pull it off so easily because there are many difficult issues to overcome, such as powder control, interface issues, high voltage stability, and solid electrolytes, in addition to the fact that cathode and anode materials themselves pose many difficulties, but the world is changing rapidly, and I think our company needs to make efforts to keep up.
Regarding progress in solid electrolytes, we have taken significant measures with our cash flow to ensure thorough implementation of capital investments. However, regarding profitability, costs must be reduced to enable actual installation in vehicles. For this reason, toward 2030 there is a need to work on various aspects, from raw materials to process technologies.

Q.
From a business model perspective, in the past I was briefed that with regard to all-solid state batteries, in addition to A-SOLiD® itself, you also intend to conduct business development by combining cathode materials and other components. This would be easier to understand if you could enlighten us as to the specifics of your sales methods and which areas you intend to focus your efforts on. Also, please tell us if there have been any changes to your approach.

A.
Although establishing business models for all-solid state batteries is an important issue, at present, we first need to introduce all-solid state batteries to the world in the years 2027 and 2028, and this is the first thing that we discuss with customers. However, at the same time, if full-fledged mass production is going to start around the year 2030, you should know that solid electrolyte powder is more sensitive to air and prone to degradation compared to standard cathode materials and anode materials. Some argue that dry powder calls for considerable care and that transporting hazardous materials will increase costs. There is also the contention that although using a slurry mixture for cathode materials and anode materials will prevent exposure to air, application as a liquid may not be competitive in the future. Furthermore, other discussions concern using sheets of solid electrolyte or cathode-anode composites as electrodes a well as using solid electrolyte sheets in place of separators, and these are being worked on as well. In any case, collaborations and discussions of the future have progressed compared to the past in order to realize future batteries and to secure competitive advantage.

Q.
In my understanding, the establishment of solid electrolyte business models is being prepared from a flexible perspective that can provide any type of response, with no specific sales target or sales method defined—am I correct?

A.
That is right. Customers and potential customers have their own views and ways of thinking, and as a company, we are engaging in dialogue appropriately.

Q.
Regarding the figures on P.5 (in the explanation materials), I believe that the various commercialization themes can be expected to contribute three billion yen or more to profits by 2030. Could you tell us about how many tens of thousands of units are presumed to be used for EVs at SE, and the size of future investments for mass production to attain this three billion yen or more of profits?

A.
Regarding how many thousands of units by 2030, we have set our assumptions at figures slightly lower than the outlook mentioned by customers. Although no decisions have been made regarding cost planning, for example, we are thoroughly investigating acceptable prices for battery pack units that are applicable for vehicle ratings, and from there, assumptions for cathodes and anodes, for cost planning, and for other elements that can be assigned to solid electrolytes. With this, instead of explaining in terms of the number of units, I believe that back-calculations for the 3 gigawatt-hours currently assumed reveal that our estimate of the annual production volume of solid electrolytes will range from one thousand to several thousand tons. We have calculated the cost at that time in our own way and configured an acceptable sales price before basing calculations on these figures. Please note that these calculations are based solely on figures seen from our company.

【HRDP®】
Q.
Regarding HRDP®, for applications, you previously explained that commercialization would proceed immediately once extremely high-end telecommunication components emerged. In reality, it feels as if the world is lagging slightly in that direction with respect to final demand. Could you explain which types of new applications would accelerate this, and how these will link to the market?

A.
Although customers do not readily disclose the details of their applications, the backdrop to the accelerated commercialization of HRDP® is that it has started to be used in high-density heterogeneous integration—in other words, semiconductor packages with structures containing many different chips. I have heard that applications of this technology range from supercomputers, high-performance computing, AI, and associated networking elements along with automotive and medical systems stemming from the same, such as those used in IoT. As for packaging sizes, they come in a wide variety of sizes, ranging from 10 cm by 10 cm to relatively smaller sizes of 3.5 cm square. I believe that the keywords describing the driving force of HRDP® use will be chips for system integration and diverse chip implementations as well as high density.

Q.
Regarding HRDP®, there is a need to implement various elements, such as silicon interposers, and also to achieve high speeds without transmission loss and electrical resistance. Would you say that these types of needs are starting to grow?

A.
That is absolutely right. With respect to conventional substrate manufacturing methods and implementation methods, we are at a stage in which we need to achieve a breakthrough in that field, and the speed of chip transmission is becoming very fast. As density has been increasing in an extraordinary way, one can think of various methodologies—such as using silicone interposers, organic interposers, or embedding components—but in any event, a carrier is needed for support. HRDP® provides support all the way from zero until device removal. Customers are conducting development within this process, and HRDP® can be manufactured more efficiently than rival technologies. The shortened process time is its greatest advantage, and evaluations to verify its applicability are underway.

Q.
Regarding HRDP®, the capacity figures shown on P.17 have increased since the explanation meeting two or three years ago. Though this is coming along faster than initial expectations, are profit and loss also moving ahead of schedule? Furthermore, although GEOMATEC Co., Ltd. is in charge of manufacturing, could you tell us which types of technologies from your company are being applied in this business?

A.
The timing of revenue contribution has not moved up, and we generally expect the schedule to remain the same. However, we are beginning to see how to boost profits, and as a company we are increasing our product lineup. Various manufacturing methods and management systems have also become necessary, and the content of investments for these are being enhanced and expanded.
Regarding combining the strengths of GEOMATEC and our company, GEOMATEC's strength is its extremely high level of thin film formation technologies, which we apply at our company. On the other hand, commercialization of HRDP® calls for incorporating various features that enable extremely short process times for customers, and our company has been responsible

for the overall development of this aspect. In addition, alongside the development, in order to establish competitive advantage through collaboration, we are also discussing the quality level customers desire with customers themselves on a daily basis as well as moving forward with our strategic partnership with GEOMATEC for the necessary management methods, equipment, and other elements.

Q.
Regarding HRDP®, there was talk about dialoguing with users at approximately 30 companies. Is this dialogue with, for instance, MicroThin™ copper foil users? Or are you moving to construct new customer bases with an entirely different approach? Is development in the form of competition or synergy possible as an extension of existing businesses? Also, please tell us what kind of customer base you have.

A.
Earlier I mentioned having dialogues with approximately 30 companies, of which 15 are now becoming more active. At our company, we call these 15 companies “mainstream.” The definition of “mainstream” is the need for 3D and chipletization, which means that supporting carriers are essential, and they are the supply chain for major semiconductor manufacturers. As HRDP® manufactures everything up to final products, initial relationships are made with end users. Mainstream supply chains cover all four categories of IDM, fabless, OSAT, and substrate. With this, we enter the designs of customers who are proceeding towards 3D and chipletization, and we have them implement horizontal deployment within their supply chains. As there is a lack of OSAT, there is substantial overlap among end users there. In this environment, improving performance through the use of HRDP® creates ripple effects to build up our track record. These 15 “mainstream” companies are a customer segment that will play an extremely important role within our future 2030 profit structure.

Q.
Is it correct to assume that HRDP® plans to develop a business that envelops these “mainstream” companies?

A.
Exactly. To materialize our move into their designs, a DOE line has been established at the GEOMATEC Ako Factory. The DOE line is not a line for manufacturing HRDP® but rather to assess whether HRDP® will be able to solve customer issues. This line has been in operation since last year, and it is now operating at full capacity. Customers visit our DOE line to confirm their issues together with us and to get to the point at which issues can be resolved before proceeding to having each end user as well as supply chain OSAT and substrate confirm the value of HRDP®.

Q.
When visualizing profit and loss from the market scale seen on P.14 for HRDP®, can we anticipate a move into the black from the end of the 2020s? Could you tell us how profit and loss is tied to market trends?

A.
Regarding profits, I hope to see profits as well as dynamically boost earnings in a positive way during the 2025 medium-term plan.

Q.
Regarding the strengths of HRDP®, at the explanation meeting three years ago, we were told that RDL-first was superior to chip-first from perspectives such as costs and yields. Could you tell us whether this is still the case now?

A.
The best description of the strengths of HRDP® is the reduction in the cycle time of customer processes. As to why cycle times can be reduced, for example, there are methodologies such as chip-last, chip-first, and chip-middle, but all of these can now be accommodated with HRDP®. 3D integration, which includes all of these methods, can now be implemented easier than rival technologies, thus enabling shorter processes. Use of HRDP® increases the potential for higher yields and reduces overall costs. As the market for using HRDP® is the 3D chiplet market, it has become a field with extremely high added value. Dropping the yield will result in a substantial increase in costs. The situation is such that verification and evaluation of materials which have the potential to be directly involved in the optimization of these costs and increasing yields are underway, and we have been achieving good results one after another.

【others】
Q.
In the Medium-Term Business Plan, there was talk about commercialization of HRDP® and solid electrolytes around the years 2027 to 2029. Could you explain, as a rough overview, how progress toward the 2030 goal of a ten-billion-yen contribution to profits is proceeding compared to how it was back then?

A.
Naturally, although the 2030 goals are not something we can say are a definite thing, I believe that the possibility of achieving them has been increasing. The speeds of customer commercialization of both HRDP® and ASSB A-SOLiD® are faster than before. Collaboration is progressing with thorough consideration of AST, samples, cost planning during initial introduction, and revenue. For example, procurement issues related to raw materials as well as recycling and reuse issues have been progressing toward concrete solutions over the past few years, and I believe that the possibility of attaining ten billion yen is higher than before.

Q.
Regarding CO2 capture, could you tell us whether this business sells materials or sells systems and equipment? How does this business earn revenue?

A.
We have been providing customers powder or pellet-level samples to evaluate CO2 capture. In addition, we are conducting consistent development of separation, recovery, and catalytic technologies along with CO2 conversion technologies while developing an overall system. Future business developments call for overall consideration of factors such as the relationships with carbon credits and target countries. If possible, we would like to provide value by selling not only powder but the system itself.