Kakenhi and Me

Michiharu Tabe
Professor Emeritus / Visiting Professor, Research Institute of Electronics, Shizuoka University

I was one of those mid-career recruits to the university. It was in 1994 that I moved to Shizuoka University's Research Institute of Electronics from NTT LSI Laboratories, and I reached mandatory retirement age last year (2016). In my 22 years at the university I received a total of 15 Grants-in-Aid for Scientific Research (Kakenhi), both large and small. My life as a researcher has thus truly been sustained by Kakenhi, and I am filled with gratitude that such a system exists here in Japan. In this essay I would like to comment briefly on the nature of Kakenhi and other things that I feel are important, based on my research experiences at Shizuoka University.

My research is about silicon single-electron devices that control the movement of individual electrons. In the second half of my career especially, I focused on structures in which a single different atomic element (dopant atom) is placed in an electron path. In these structures, known as single-electron/single-dopant-atom devices, the flow of single electrons through the single dopant atom determines the overall input/output properties. This is not only a highly novel device but also one that is beautiful in its simplicity, as well as having special features such as ultra-low energy consumption. I pursued my research on it in the hope that one day it would occupy an important position in the field of electronics.

In retrospect, I realize I had a fortunate start to my research: I applied for Kakenhi in order to supplement the meager routine research funds I received immediately after moving to the university, and was selected for a Grant-in-Aid for Scientific Research (B). Later, after a difficult few years, I was able to obtain several relatively large-scale Kakenhi grants including two Grants-in-Aid (S), a Grant-in-Aid (A), and a Grant-in-Aid for Scientific Research on Priority Areas, allowing me to focus solely on research. Large

Kakenhi grants are of themselves nothing to be especially proud of—Nobel Prize-winning research is often carried out on small-scale grants—but experimental research in electronics does require a certain scale of funding. Thanks to my series of Kakenhi grants, I was able to establish a basis for research in the long term.

Financial support was not the only blessing that the Kakenhi system brought me. I also learned valuable lessons from my unsuccessful applications. University faculty are almost never subjected to harsh criticism of their research activities by those around them. They tend to become absorbed in their own world of research without ever encountering unfavorable feedback. I was able to make a promising start by obtaining a Grant-in-Aid for Scientific Research (B) shortly after moving to Shizuoka University, as explained above, but from around the time that the first grant expired, several Kakenhi proposals that I considered to be certainties were rejected, leaving me struggling for a time to make do with other small-scale Kakenhi grants. Nonetheless, I began to think of these frequent rejections as valuable, candid advice from third parties, and resolved to use them as opportunities to re-appraise my own research. After much trial and error, I achieved a change of trajectory and began working to elicit ordered properties such as single-electron transfer from the disorder that is an inevitable feature of nano-structures—a unique approach with no precedent anywhere else in the world. Fortunately, I was able to attract many talented international doctoral students, and this shift in my research yielded results even quicker than I had expected, leading to my first Grant-in-Aid for Scientific Research (S). Moreover, I extended this research into the area of dopant atom devices, which was later to become my central research theme. I was also encouraged by a prize from the Minister of Education, Culture, Sports, Science and Technology, awarded in recognition of the outcomes of this research. In this way, it is certainly true that being selected for Kakenhi grants helped my research to progress, but I can also say that being rejected was an important educative experience for me.

As the government’s operating expenses grants to universities decrease year by year, for university faculty, being granted Kakenhi is a critical factor that determines whether or not they can sustain their research. Even just one or two years without any support from external research funds spells the suspension of a research project, and the damage caused thereby can linger into future years. As mentioned earlier, rejections often serve as valuable lessons, but of course the continuity of research is vital. This is why the current Kakenhi average success rate of 20-30 percent is insufficient; surely we need a

new, additional framework to support the continuity of research. I wonder, for example, if it would be possible to set up a basic research grant scheme that extends to around half of all researchers, even if each individual grant needs to be small, as a way of raising overall research capacity in Japan. It is inherently difficult to judge whether or not a research project will bear fruit in the future, so a system that relies on heavy screening is likely to have adverse effects. I believe that research is something that does not lend itself well to excessive competition as well as selection and concentration.

Lastly, I would like to comment on two factors other than Kakenhi that have supported my own research. The first is the contribution of international doctoral students. The progress of my research was aided greatly by nine talented doctoral students from partner institutions in central/eastern Europe such as Warsaw University of Technology (Poland) and Alexandru Ioan Cuza University (Romania), and those in Asia including Universitas Indonesia. Each of these students shared a strong commitment to pursuing research at a high international standard. Underpinning my opportunity to supervise so many international students were the international research exchanges that had been pursued at grassroots level by faculty members over many years. The Ministry of Education, Culture, Sports, Science and Technology's special program for priority placement of Japanese Government Scholarship Students also played a major role. I strongly feel that these kinds of long-term educational programs provide the foundations for building research capacity. The second factor I would like to point out is the importance of joint-use laboratory facilities on campus. In order to pursue my kind of research at a university, it is essential to have at least a minimum level of apparatus for the manufacture of electronic components and a cleanroom environment. Accumulating the necessary facilities using only individual external research funds is an impossible task. I was lucky in that the Research Institute of Electronics has a common-use cleanroom. It is by no means a large or impressive facility, but it is a place where researchers can each bring in their own apparatus to be used in common. It was thanks to this environment that I did not give up on my device-related research. However, there is a limit to what can be achieved through self-help alone; a degree of budgetary commitment is also required. Surely we can find ways outside the Kakenhi framework to outfit and maintain facilities that will support the many seeds of new research.