

Grant-in-Aid Support for Advancing Bioelectrochemistry  
at the Dawn of Its Area

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There are times in the midst of the everyday toil of running the university that I find myself yearning for the more languorous days when I was a researcher. I recall with nostalgia scrapping together money from Grants-in-Aid to travel from conference to conference reporting on my research work. Happily, I am still invited to international conferences in both Japan and abroad to deliver lectures on my research to date.

Whenever I do so, I always thank my colleagues and audience for their care and support in the wake of the Great East Japan Earthquake, then introduce them to Kumamoto University. That I am now in a position to give these lectures owes to the long years of support my research has been blessed to receive from Grants-in-Aid. As I am currently serving on a committee to evaluate research being conducted in new scientific realms, I have the opportunity to stay abreast of cutting-edge research advances. I really enjoy this chance to communicate with researchers exerting themselves on the frontlines of scientific pursuit and hearing about the progress their efforts are yielding.

Given the current strain on the operating budgets of universities, Grants-in-Aid have become critical to advancing research in them. At Kumamoto University as well, the faculty is urged to secure Grants-in-Aid and other external funding so as to ensure the quality of the university's research and education. At the same time, I try to raise the faculty's awareness of the fact that it is the people's taxes that are the source of Grants-in-Aid, and encourage them to use the funds in ways that produce research results that will satisfy the public's piercing gaze and high expectations. This goes for all their research activities, irrespective of whether they are short or long in duration.

Looking back, there has been synchronicity between my career as a researchers and my relationship with Grants-in-Aid. Compared to the days when I was first hired as a member of Kumamoto University's faculty some 35 years ago, a stark difference exists

in the condition of university research labs. Back then, we had very little research equipment in our lab, so we had to scurry about searching for advanced high-grade instruments in other departments and even other universities. As a positive aspect, however, it gave me a good opportunity to get to know many researchers outside my own lab and institution. However, we couldn't carry out our research unless the lab was equipped with the necessary general-purpose instruments, so we had to supply them. As our research advanced little by little, we started to apply for Grants-in-Aid based on the results. I can vividly recall how elated I was the first time we were selected for a grant. Thought it was for a total of ¥700,000, just having been selected gave us the feeling the society had recognized our existence. Feeling joy and pride, our impulse was to "surge forward."

So it was that we began conducting our electrochemical research on biological molecules. I had purchased a Japanese-made small electronic potentiostat and pen recorder, which had just come on the market. While writing and reporting a number of research papers, I applied wherever I could to private research-grant organizations for funding, gradually garnering support. In the latter half of the 1970s, worldwide attention was drawn to access directly to biological molecules by electrochemical techniques that had theretofore been deemed impossible: It involved measuring the electron-transfer reaction of metalloproteins on an electrode using a direct electrochemical process (measurement: voltammogram = current-potential curve). While working to equip our lab, my group decided to resolutely take up this challenge. In the early 1980s, we were fortunate to be able to contribute to a big leap forward in that direction through our direct electrochemistry-related research on metalloproteins. We demonstrated the possibility of direct electrochemical measurement of metalloproteins using functional electrodes, which we did by fabricating and assembling a variety of modified electrodes. We succeeded to prepare them after many trials by modifying the functional molecules on their surfaces, which was a world major trend in research at that time.

Most saliently, in the process of our work to construct a functional electrode interface for controlling the electron transfer of cytochrome c, we were able to produce an easy-to-use wet modification process for gold and silver electrode surfaces using disulphide and thiol compounds. Thereafter, the SAM (Self-Assembly Monolayer) boom spread around the world. This method is now widely applied as a 21<sup>st</sup>-century key technology for altering the properties of solid surfaces. Next, we succeeded in fabricating functional electrodes capable of measuring direct electron transfer of ferredoxin and myoglobin in

addition to cytochrome c. That enabled the rapid development of the fields of bioelectrochemistry, using simple electrochemical approaches. With the subsequent elucidations of the electrode surface on the atomic and molecular levels, electrochemical research merged with various fields of the nano-science. Concurrently, there has been a rapid development of application fields for electrochemical processes, such as biosensors, functional measuring devices, and along with the elucidation of electrode catalytic activity, the development of electrodes for energy conversion and of new bio-batteries.

As these advances intersected various other research trends around the world, we were able to participate in pioneering a new international scientific developments in bioelectrochemistry of metalloproteins. In its dawning phase, many international symposiums were held, giving me the chance to travel around the world.

What supported these research activities throughout was a steady stream of Grants-in-Aid. At first we received grants under the category “Encouragement of Young Scientists” and, then, relatively continuous support under the category “Grant-in-Aid for General Scientific Research.” For offshoot applied research, we were awarded grants for “Developmental Scientific Research.” I was appointed a member of the application-drafting team for several “Specially Promoted Research” and “Scientific Research on Priority Areas” grants, and headed the project-planning team for another grant in the latter category. Through my involvement in these many grant-supported projects, within a short period I was able to form collegial ties with many researchers in and outside of Japan. These people have been a wonderful asset, one that I wouldn’t trade for anything. I would avail myself of the cooperation and support of many of those colleagues in ensuing years.

Of late, grant support for young researchers has been substantially improved over what it used to be. Contrastively, it feels as though grant acquisition has become somewhat more difficult for older researchers. Concomitant with stronger support for young researchers, the use of Grants-in-Aid has been made a lot easier through the establishment of a Fund that allows grants in some categories to be used across multiple years. While these enhancements have been long desired by researchers, the Grant-in-Aid budget has also been increased to ¥260 billion. This pleases me immensely.

Whereas virtually all grants were paid in two installments this fiscal year and it was

rumored that their amounts could be reduced, happily they were all disbursed as initially stipulated. Over the short term, it will be necessary to provide budgetary support for restoration of the earthquake devastated areas in northeastern Japan; over the mid- to long term, however, dedicated support will be needed to generate the kind of new knowledge assets that will undergird Japan's future as an advanced nation. In the future as well, the role Grants-in-Aid play in supporting basic research must be enhanced so as to broaden Japan's intellectual infrastructure, upon which Japan's development will continue to advance. At the same time, it is my hope that researchers will sharpen their perception of Grants-in-Aid being equal to the "people's money"; and so incentivized, press forward with a sense of mission in responding to the needs and expectations of the Japanese citizenry—and the wider global society.