Opening Article

A direction for industry-academia-government collaborative research

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In recent years, large-budget research grants have become prominent, and competitions to secure research funding have become intense. This is probably the result of legislation aiming to establish Japan as a leader in science and technology, but it seems many researchers appear to be busy trying to secure and manage research funding as a result and losing time to focus on their research. Lowering researcher morale is also an issue. Furthermore, younger generations are continuing to become distanced from science and technology, perhaps as a result of observing such situations in the research field. I cannot but feel that something very important is being neglected.

One of the missions of chemists is to develop useful compounds and materials. It seems that we are losing the patience and tolerance to evaluate and support down-to-earth research exemplified by the simple process of placing a substrate inside a flask, observing the progress of ensuing reactions, and extracting the objective materials.

Without wishing to be criticized for attention seeking, I would like to introduce some results that our research group has produced. There had been many expectations on polymers obtained through ring-opening polymerization of benzoxazine as viable aircraft materials due to their excellent heat resistance and mechanical strength. However, polymerization temperature is high, and desorption of critical constituent (volatility) posed problems. As academics, we started out by trying to explain the polymerization mechanism. This led to the development of a high-activity catalyst and a high-activity monomer opening up the path to the commercially viable use of benzoxazine for aircraft materials. In addition, amino acid *N*-carboxyanhydride (NCA) is an important monomer that gives rise to polypeptides during ring-opening polymerization, but the synthesis process required the use of a deadly poison called phosgene. We analyzed the reactivity of the amino acid carefully, and carved out the path to NCA synthesis using diphenyl carbonate (DPC) as an inexpensive and safe substitute for phosgene. This methodology will lay the foundation for the rise of the polypeptide industry.

It was a diligent and modest attitude with respect to chemical reactions taking place inside a flask that led to these outcomes. This kind of attitude develops into unwavering confidence and supports the independence and autonomy of the chemist within the industry-academia-government collaboration. This independence and autonomy is indispensable in order to embody the three elements: "trust" through respecting each other; nurturing the "friendship" in which opinion can be exchanged openly; and "responsibility" of each role. Thus the construction of win-and-win relationship becomes possible in the collaborative research. The "win" on all parties can be summarized into the "four Ps". Academia that converts 0 to 1 through researches; industry that quickly elevates this to 2 or more by converting research outcome to Production; then the Patent and research Paper are developed driving both parties forward; corporations then generate Profit which leads to the stimulation of the country's economy.

The independence and autonomy of chemists implies diligently working with flasks and engaging in research without being deluded by fashion. By constantly questioning oneself so not to become a floating weed by forgetting this basic principal, a guiding light will shine on a direction which industry-academia-government collaborative research should follow.

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