

Chemical and Material Science for Humanity and Social Science

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Abstract: This is based on the outline of an invited lecture at an international conference on the theme of "Science and Society". Based on chemistry, I analysed an old painting for art conservation. Recently, I have picked up chemical terms found in history textbooks. The use of materials (excluding food and medical) may be classified into money, weapons, energy, clothing, building etc. Technical restrictions must be significant different from normal history from the viewpoint of arts or humanity such as war, politics, economy, and culture. As for biology and earth science textbooks, chemistry and physics played a fundamental role for explanation of certain phenomena. Chemistry is also important in resource economics and court appraisals. Interdisciplinary research often faces gaps between disciplines even in natural sciences. In contrast to success about fire explosion dangerous substances from the viewpoint of inorganic chemistry, I failed to collaborate with mathematician for discussing chemical studies. Collaboration is difficult without the same values and mutual understanding, though cartoons and parables may be effective for enlightenment and education.

Keywords: Chemistry; Humanity; Social Science; Natural Science; Mutual Understanding

Commentary

Humanity and social science and chemistry should be related somewhat. However, such interdisciplinary research often faces gaps between disciplines even in natural sciences. Actually, I failed to collaborate with mathematician for discussing chemical studies. In differential equations for a chemical reaction of mediator system, is it important or attractive for phenomenon mathematicians? How to apply "mathematical" models in this case?

Among my researches, we have investigated composition of inorganic materials used on the base of oil painting drawn in the 18th century (Fig. 1).^[1] The motivation of such study was typically improving methods of art conservation with the aid of chemicals. As for analytical chemistry, scientific appraisal using XRF and examination of the legitimacy of the appraisal in arsenic curry case was also a famous in Japan after request for retrial. In a recent book of economics entitled "world history of resource struggle", materials of important resources (e.g. spices, money metals or changes of main energy materials such as oil / coal / natural gas / renewable energy in near future) were mentioned from the view point of modern economics, current geography, and world history mainly. Indeed, some of Grenoble's EU organizations are located in a historic coal dispute area between France and Germany.

By the way, "technical law" or regulation should be more associated with natural sciences. The Fire Service Act in Japan (law), for example, stipulates six types of dangerous goods or materials. I have carried out a lecture for graduate students to explain chemically why substances in the law are dangerous.^[3] For example, Category 3 (spontaneous combustibility, prohibited aqueous) contains Trimethylaluminium. Trimethylaluminium dimer, which is isoelectronic diborane, is one of the simplest examples of an organo-aluminium compound. It exists mostly as a dimer at room temperature and pressure, analogous in structure and bonding to diborane. As with diborane, the molecules are connected by 3-center-2-electron (electron deficiency) bonds, namely the shared methyl group's bridge between the two aluminium atoms. This is the reason why it is unstable, in other words, dangerous. Although this law has many descriptions about technologies in other fields such as buildings and purely laws and regulations, this lecture of engineering and the related article^[3] can be said to be the content of the category of science and technology after all.

Once I have carried out survey of high school textbooks in Japan (history and other sciences) from the viewpoint of chemistry to elucidate the relationship of many subjects. In Japan, "World history is made of chemistry" was one of famous primer books of chemistry recently.^[4] The book explained the impact of chemistry on history with popular materials or chemical technologies such as fire, food,

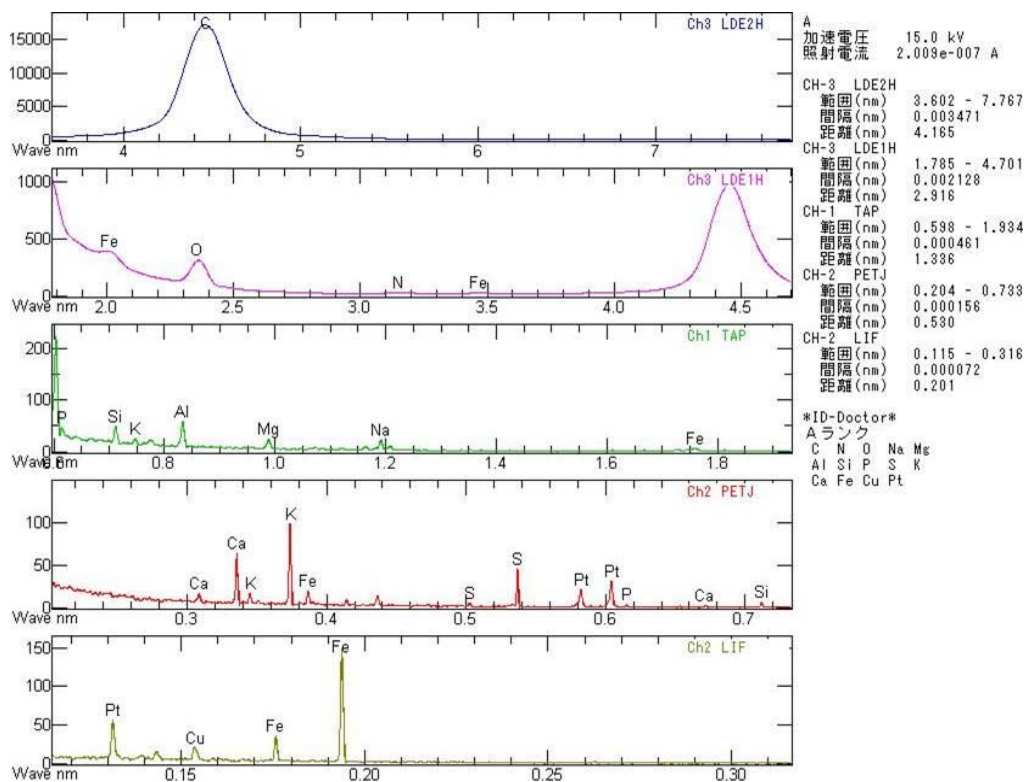


Fig. 1. Analysis of elements in the samples taken from an old oil painting picture.

alcohol, ceramics, glass, metal, gold / silver, dyes, powerful drugs, narcotics, explosives, chemical weapons, nuclear weapons and so on.

In contrast, I investigated official high school textbooks checked by government (MEXT) on world history, Japanese history, and for comparison, biology and universe and geoscience. As for world history, important technologies picked up were money (silver, gold, copper, alloys), weapons (bronze, iron, gunpowder), energy (firewood, coal, oil, natural gas), clothing (silk, cotton, polymers), and building (stone, glass, metal, lead). Historical lead manufacturing method in Europe may result in the Notre Dame Cathedral Fire in 2019 and lead harm after this accident. Japanese historical technologies were introduced from abroad or unique and independent culture such as money metals (silver, gold), weapons (iron, gunpowder), energy (firewood, coal, oil), clothing (silk, cotton, polymers), building (stone, wood, paper), materials (glass, ceramics). Ceramics are not only for practical use but also art or culture. In the construction of the Great Buddha of Nara, which was erected in the 8th century, the poison of mercury to obtain copper must have been a problem with the technology at that time. Which is premised on the transmission of religious beliefs and the spread to politicians.

For better partnership of Humanity and Science, relationship of chemistry and other natural sciences may provide good hints. In high school biology, biochemical reactions, biomolecules, and molecular level biological or biochemical phenomenon are closely associated with (high school level) chemistry. Chemical properties or features lead are related with mechanism of action of lead poisoning mentioned above to some extent. Universe and earth science deals with elements in earth and universe; substance and physical

Chemistry; minerals, air, water, and soil. From knowledge of ceramics, crystal structure of minerals (metal oxides) in the earth can provide fundamental role for explanation by chemistry.

By the way, currently, under the pandemic situation of COVID-19, efficient removal of the causative virus SARS-CoV-2 is undoubtedly an urgent social challenge. Therefore, disinfectants such as alcohol are often used for hand washing and wiping, but there are also uses such as food that are not suitable for chemicals, and decomposition of virus molecules by light is worth considering and can be said to be significant. The research group of the representatives has been studying the destruction of protein molecules by infrared free



Fig. 2. "Atomic Bomb Dome", Hiroshima, Japan.

electron laser irradiation. Recently, he discovered that the secondary Structure becomes more fragile by binding metal complexes. They have used ligand docking calculations based on the crystal structure of proteins. Therefore, performing ligand docking calculations of some metal complexes and SARS-CoV-2 may be a proper method.^[5]

However, such interdisciplinary research often faces gaps between disciplines even in natural sciences. Actually, I failed to collaborate with mathematician for discussing chemical studies. In differential equations for a chemical reaction of mediator system, is it important or attractive for phenomenon mathematicians? How to apply “mathematical” models in this case?

In conclusion, I conclude with an extreme example (Fig. 2), but sometimes it doesn't matter about other fields. Several years ago, I have visited to “Atomic Bomb Dome”, Hiroshima, Japan. Hiroshima and Nagasaki were used atomic bombs in war actually during human world history (in 1945). Even if nuclear physics or chemistry were technically possible, this would not have been the case unless war and social judgment were possible.

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