

Extended Abstract of PSA-19

O-01

Toward Construction of Measurement/Characterization Platform for Open Innovation

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Recent Japanese activities to construct measurement/characterization platform were introduced based on the output of the special committee of JSPS and of the NEDO project. The concept and trial of common data format for combined analysis were also introduced. .

1. Need for Measurement/Characterization Platform

Measurement and characterization technologies have been applied not only to accelerate research and development (R&D) of new functional materials/devices but also to maintain the quality of those materials/devices by solving various practical problems on production lines. The technologies including surface analytical techniques/instruments are supporting infrastructures for creating innovation in Japan through their application to “monozukuri” manufacturing (mainly primary materials industry), which is one of Japan’s characteristic strong points. Therefore, close cooperation is highly required between the measurement instrument industry that supply these technologies and the primary material industry that use them, especially in the era of open innovation.

From this point of view, the JSPS (Japan Society for the Promotion of Science) established in October 2014 the special committee with the title of “Construction of Measurement/ Characterization Platform Strategy for Open Innovation” as one of the committees for research promotion in specialized areas. About 30 members engaged in the committee: one half of the members were from academic sectors and the other half of them were from industrial sectors. Members from Japanese

top 5 measurement instrument companies were selected together with members from Japanese major chemical (material) companies and electronics (device) companies. The committee closed in September 2017 after three years assigned time with publishing the report of the activities [1]. The purpose of the present abstract is to introduce briefly the core part of the committee activities, and the activities relating to the successive national project described below.

2. Brief Summary of the Activities of the JSPS Special Committee

In the committee, measurement/characterization platform was discussed mainly from two aspects: one was instruments/system aspect, and the other was data/knowledge aspect. The main point for the former was the consideration of instruments/system which should be developed and placed with taking the operation of them into account. The main point for the latter was the utilization of data/knowledge that would be stored and accumulated in the platform. It was noticed through the discussion that the practical needs of “monozukuri” manufacturing were the application of combined (and/or integrated) analysis methods in the measurement and characterization of materials/devices, and the application of artificial

intelligence (AI) technologies to data/knowledge obtained by measurement and characterization.

It became clear, therefore, that the output data of an instrument for measurement/characterization should be able to be used both inside of the instrument (i.e., use in physical space) and outside of the instrument (i.e., use in cyber space). The adaptability for the use in cyber space led an idea of common data format for various measurement instruments. The idea was discussed further in the Software WG (working group), which was set in the committee together with other working groups of Hardware WG, Solution WG, and Standardization WG. It was agreed in Software WG that the common data format should be flexible enough to ensure, together with measured data themselves, the following necessary information, i.e., reliability, reproducibility, uniqueness, and traceability of the data.

3. Brief Summary of the NEDO project

The concept of the common data format was demonstrated and checked by the project of "Research and Development of Innovative Analysis/Evaluation Technology with Adaptability to Big Data", which is one project of "Advanced Research Program for Energy and Environmental Technologies" organized by NEDO (New Energy and Industrial Technology Organization). The project started in January 2017 and ended in January 2018.

Nano particle measurement system [2] was used as a model cyber-physical-system (CPS) for combined analysis. The system was composed of 6 different instruments made by 4 measurement companies: That is, ICP-MS and CF3 (Centrifugal Field Flow Fractionation) by SHIMADZU CORPORATION, SEM/TEM by JEOL Ltd, AFM by Hitachi High-Technologies Corporation, and DLS (Dynamic Light Scattering) by HORIBA, Ltd.

Two research subjects were set in the project: Subject 1 is R & D of data converters using a standard data format defined for nano materials, and Subject 2 is R & D of a testing methodology for nano materials by using an integrated viewing of multiple measurement results. A model (common) data format with tentative name of XMAIL (Extensible Measurement/Analysis Instrument Language) was developed in Subject 1. It had four

categories of <document>, <protocol>, <data>, and <eventLog> to guarantee measurement/analysis quality such as traceability, reliability, reproducibility, etc. Moreover, two new tags were defined to ensure versatility of data expression and uncertainty of data. XMAIL Library and the converters for 6 instruments of 4 companies mentioned above were developed. It was confirmed that the new tags could express all data necessary for the measurement of nano-particles.

In Subject 2, prototype of an integrated data viewer for combined analysis of nanoparticles had been successfully developed. The viewer was designed with a measurement system consisted of a fractionation unit and sizing units. It was confirmed that the results could be displayed and processed in an integrated way by the viewer with handling measurement data obtained by 6 different instruments. In order to clarify metrological traceability and reliability, fish bone diagrams (FBDs) were created for each measurement unit and fractionation unit. In addition to Subject 1 & 2, the possibility of a common sample holder for instruments with capability of imaging analysis was also studied. 6 instruments from 4 companies were chosen, and precise mechanisms of sample holding, position adjustment, etc. were surveyed.

Details will be introduced in the presentation.

Acknowledgement

The abstract reports the results obtained by joint activities of the JSPS special committee and the NEDO project. Members of the committee and the project are highly appreciated.

References

- [1] Report of the special committee of "Construction of Measurement/ Characterization Platform Strategy for Open Innovation", Japan Society for the Promotion of Science (September, 2017) (in Japanese)
- [2] Look at the homepage of Consortium for Measurement Solutions for Industrial Use of Nanomaterials
<https://unit.aist.go.jp/rima/nanoscp/coms/nano/>