A View of Key Recent Developments at LNE

Plática Plenaria

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ABSTRACT

The laboratory of thermal and optical properties of materials is one of the major units of the division "thermal & optical metrology", itself one part of the centre in charge of the Scientific and Industrial Metrology activities.

Its activities are growing at two levels; one hand basic and applied Research and secondly the dissemination of measurements or calibrations, as well as the knowledge transfer to serve Industry, Research and Society.

The priority actions today affect the areas of sustainable development (environment, energy, health care) and any matter relating to the economy, the nation and citizen in accordance to the French government policy and to European directives.

In recent years the works of the laboratory metrology devoted to thermal and optical properties of materials have been motivated by 3 major issues:

- In Europe liberalization of the energy markets has generated greater competition between energy producers, distributors and service companies. This has led notably gas producers to seek to enhance their knowledge on the thermal properties of natural gas. To this end the development of a high accurate calorimeter for measuring the Gas Calorific Value (GCV) of the natural gas has been set up in close cooperation with key stakeholders and European metrology experts in that field. Today this facility, after designing a prototype based on numerical modeling, is being experimentally characterized for measuring the GCV of the Methane. The main other constituents of the natural gas will be studied shortly.
- The Kyoto Protocol has generated a significant increase in activities in the field of energy and environment in France. For building applications, the goal is to lead to a better control of energy losses, but also regarding the release of greenhouse gases in the atmosphere. To this end, reference metrology installations for measuring the thermal conductivity and thermal diffusivity of materials were developed. Different Inter-laboratory comparisons enabling a high level metrological validation were launched. For instance, the thermal conductivity measurements on insulating materials such as glass fibers (CRM - IRMM 440), or expanded polystyrene (EPS) as well as the thermal diffusivity measurements on POCO graphite have been performed. The latest developments in progress concern the thermal conductivity measurement of materials covering the range from 1 up to 5 $W.m^{-1}.K^{-1}$ such as for polymers, plastics, ceramics, composite materials, glasses…in applying the guarded hot plate technique. In addition, for solar or high-tech aerospace applications, control of radiative properties in energy balance calculations is quite crucial. In this context, the laboratory has developed a technical platform which is composed of various advanced spectro-radiometric means in order to meet the most common configurations needing a low level of uncertainties (typically around 1%).
- In the field of health, high stakes of the prevention, treatment, and management of disease is a key point. Ongoing projects refer to dedicated optimized spectrophotometers. They aimed at improving the traceability of measurements performed in analytical laboratories especially in Biology. The spectral transitivity measurement on optical slabs constituted with many samples is one of the recent developments leads by the laboratory.

This R&D laboratory has developed so far competencies and facilities for studying solid properties of materials. As stated in the different subjects mentioned above and ongoing studies, interest in the properties

of gas and liquid (molten metals) are a major thrust for development of the metrology laboratory. These actions complete research activities in the field of metrology in many areas and especially thermics (temperature fixed-points) or optics (laser calorimetry, heat fluxmetry…) where the need for data of properties of materials validated is essential for improving the measurement uncertainties relatively to the different scales of metrology.

This talk is intended to highlight the R&D activities in the field of thermal and optical properties being carried out by LNE in France in a European context but also International where networking is becoming a priority to respond effectively to the expectations of the issues facing society today.