DEVELOPMENT OF A SAXS EQUIPMENT FOR NANOMATERIALS CHARACTERIZATION

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Abstract. With the increase use of nanomaterials increasingly seeking the creation of techniques and equipment to determine properties of interest in the nanometer scale. Thus, the technical SAXS (Small Angle X-Ray Scattering) allow the analysis of nanomaterials and determine various parameters such as particle size, density and morphology of nanoparticles. Normally, X-rays pass through the sample (the transmission mode) and each particle interacts with the X-ray emitting a signal which is detected and analyzed. As in all other areas of research, there are major challenges to the development of instrumentation for the application of this technique. The challenges of this research are the optical part of the project, from the platform of conventional X-ray diffraction equipment. The X-ray beam must have the smallest possible attenuation and this condition is obtained with the evacuation of all traveled optical path which includes the chamber where the sample is placed and the X-ray bidimensional gas detector.

1 Introduction

The devices that are used in the characterization of materials played an important role in the research of new materials. But many of them become obsolete when it comes to the study of nanomaterials. The SAXS equipment is a powerful tool in development and research at the nano scale, allowing the precise details of the structure of materials, defining the arrangements, shapes and the density of the crystalline structure. The progress made in the study and development of nanomaterials, emerged in parallel and as a result of these advances, the need to employ SAXS techniques to improve understanding of the different properties that these materials present in relation to the microscopic properties. Due to the cost factor, the instrumentation of this nature are extremely scarce in developing countries, as they are marketed with high values, in many cases prevents the acquisition of this equipment even by major educational institutions and research. Thus, from conventional X-ray diffraction equipment, instrumentation will enable the implementation of SAXS technique is developed, where the entire optical path traveled by the X-ray beams to reach the two-dimensional detector gas will be evacuated. Thus, from conventional X-ray diffraction equipment, instrumentation is developed which allow the application of the SAXS technique in which the entire optical path traveled by the X-ray beams to reach the bidimensional detector gas will be evacuated. The whole course of the X-ray beam, including the sample port should be free of particles that can reduce its intensity. The collimation of the flux of X-ray beams will also be developed.

2 Design and instrumentation

The base equipment, disposed for the preparation of this work is Siefert HGZ-4, which will go through two stages of reconstruction. In the first stage, this was done in partnership between the UERJ (Universidade Estadual do Rio de Janeiro) and the CBPF (Centro Brasileiro de Pesquisas Físicas), restructured and reshaped all the electronics and control system part as: replacement of stepper motor system, the encoder and the clutch system and the goniometer axis. The second stage is the part where this work is inserted, foresees the development of the SAXS optics, construction of the collimation system X-ray beam, the design and placement of the bidimensional detector. In the design of components that will compose the optical parts of the equipment are the gas detectors, developed and manufactured by CBPF,

which dominates this technology.

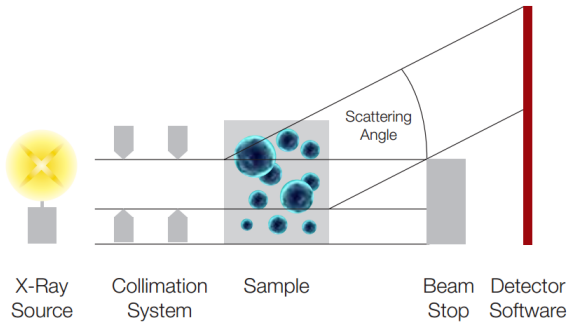

Figure 1: Schematic composed of (left to right): X-ray source, collimator, sample, scattering angle, beam stop and detector [1].

3 Results and discussion

This project because it is multiple steps and different areas of expertise, became a challenge that gradually has been overcome, since all the electronics and control system were completely reconstructed and finalized, getting ready to design phase and instrumentation that are underway and which will be developed using national technology in the development of equipment that allows the use of SAXS techniques.

4 Conclusion

This design will contribute in the development of extreme importance equipment in the development and research of new materials and can be subjected to a patent, as the technology employed in gas detectors developed in CBPF holds an international patent and configuration of any instrumentation will compose this equipment, establishes a new application of this technology.

References

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