Understanding the structure of materials with a high degree of structural disorder using electron diffraction

In materials science, the determination of the atomic structure of materials is fundamental to the understanding of their properties and the development of new applications. Crystalline structures can be successfully determined using traditional techniques such as X-ray diffraction (XRD) and electron diffraction (ED), which are performed in transmission electron microscopy (TEM). Over the years, these techniques have been refined and successfully applied to the analysis of metallic, inorganic, and organic materials, along with the determination of complex materials such as proteins. However, new techniques are necessary to study the structure of materials that present a significant degree of disorder such as amorphous and nanostructured materials. For example, nanocrystals show a highly diffuse XRD pattern, which makes its interpretation very challenging. In the last decade, pair distribution function (PDF) analysis based on X-ray or neutron total scattering data has become a mature and well-established method capable of providing quantitative information of the atomic structure in amorphous and nanostructured materials. However, the execution of good PDF analysis depends on special installations, such as Synchrotron and Neutrons diffraction facilities, with low accessibility. In this presentation, I will analyze and review the current progress and challenges in using ED to obtain PDF, i.e., the ePDF, as an important characterization tool to obtain structural information of materials with a significant degree of disorder. I intend to show the advantages of using the ED obtained in a conventional TEM to analyze nanomaterials, amorphous materials, and frozen liquids via PDF.