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Combining synchrotron radiation and Crystallography to decrypt the structure of materials impacting Energy, Environment and Health

Anna Moliterni
Institute of Crystallography – CNR, Via Amendola 122/O, Bari, 70126, Italy

The knowledge of the crystalline materials at atomic scale is essential for having insights into the structure-property relationships and reveals itself particularly appealing in case of crystalline compounds impacting fields relevant for the quality of the human life, like Energy, Environment and Health. Crystallography is the key science to unveil the crystal structure from diffraction data.
The success of the *ab-initio* structure solution process of crystalline materials based on conventional laboratory X-ray diffraction data can be prevented by the small crystal size and/or the low crystallinity and weak diffraction power of the investigated compounds. These limits can be overcome thanks to the use of synchrotron radiation, allowing to successfully characterize new compounds in spite of the small size of the investigated crystals and/or the structural complexity. Consequently, in the case of challenging compounds, synchrotron radiation is often the obliged choice making the difference, as proved by some recent successful structure characterizations of new materials of interest for Energy (*i.e.*, hybrid organic-inorganic perovskites [1-4], *via* powder diffraction [1] and single crystal diffraction [2-4]). Recently, the use of synchrotron radiation paved the way also to the structural investigation of nanocrystals of metal chalcohalides by powder diffraction, *e.g.*, in the case of bismuth chalcohalides [5], new materials with appealing optoelectronic properties.
Some recent outcomes on the structural characterization by synchrotron X-ray diffraction data of compounds impacting Energy (*i.e.*, new hybrid organic-inorganic perovskites [1-4] and metal chalcohalides [5, 6]), and Environment and Health (*i.e.*, an asbestos fiber, remained in a human lung for ≈ 40 years [7] and an erionite fibre from Tuzköy village [8]) will be described.

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