In the Footsteps of Pasteur: Identifying Conglomerate Systems Using State-of-the-art Electron Diffraction

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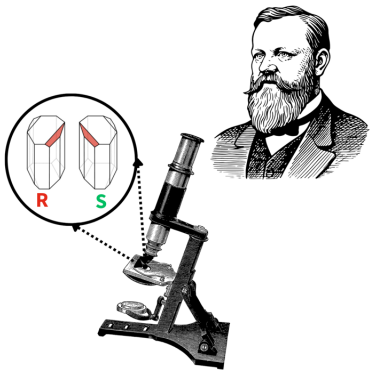
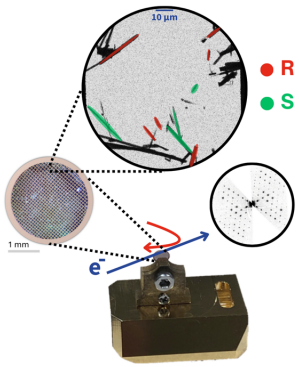
Chirality is a key concept in structural chemistry and of crucial importance whenever biological systems are concerned. Ever since Pasteur managed to separate the first conglomerate in 1848, research of chiral compounds is closely related to crystallography and single crystal X-ray diffraction is currently the standard method for absolute structure determination of chiral molecules or chiral molecular assemblies. In Pasteur's example of sodium ammonium tartare tetrahydrate, the racemic compound crystallizes as separate enantiopure crystals, a so-called conglomerate – which allowed him to inspect individual crystals under the microscope and manually separate them by recognising their hemihedral faces. Most racemates (>90%), however, form racemic crystals, so the identification of conglomerate systems is important for chiral discrimination, which allows separation and purification of chiral molecules and chiral supramolecular assemblies in the solid state.

The advancement of electron diffraction (microED, 3D ED) makes it possible to identify conglomerates with an modern version of Pasteur's method. Diffraction data can be collected from individual crystals of a racemic powder sample and dynamical refinement allows the determination of their absolute structure. In the presented case study, the method was applied to chiral benzyl (p-tolyl) sulfoxide and achiral benzyl (p-tolyl) sulfone, which both crystallize as chiral crystals. The electron diffraction results unambiguously prove the presence of both enantiomorphs and therefore identify them as conglomerate systems. For the achiral sulfone, where chirality only exists in the solid state, this allowed the preparation of an enantiopure sample by Viedma ripening. With fast measurement times and the ability to work with powder samples and very small sample amounts, electron diffraction has the potential to establish itself as a new standard method in screening for conglomerates.



Louis Pasteur
1848



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