

Chiral recognition on surfaces: from single molecule tracking to 3D crystals

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The emergence of homochirality in biomolecular systems is one of the most intriguing open questions of Nature. The self-assembly and amplification of chiral subunits into higher-order species is crucial in understanding the development of homochirality in biological function. Apart from being related to the very first organic molecules synthesized on earth, understanding the basics of chiral recognition and discrimination is of high technological relevance. In fact, the chemistry and technology of production and separation of enantiomers has evolved into a branch of materials science under the name of Chirotechnology.

In this scenario, our work aims to get an insight into the fundamental aspects of chiral recognition, under the main inspiring question: How does chiral recognition take place at the single molecule level? and secondly: How can we tune the expression of chirality on a 2D template to achieve stereoselectivity for the growth of 3D crystals?

By tracking the conformational dynamics of adsorbed dipeptides on Cu(110) by scanning tunneling microscopy (STM) we have recently shown that chiral recognition takes place at the single-molecule level via the general "induced fit" mechanism developed by Pauling and Koshland more than 50 years ago.

Moreover, we can now show that fully patterned biomolecular chiral surfaces can be created by two novel methods: tuning the expression of supramolecular chirality by molecular engineering of chiral adsorption sites (footprint engineering of aminoacids) and 2D co-crystallization (mixed phases of achiral and chiral molecules) under ultra high vacuum conditions. Recent developments on diastereomeric recognition and selective crystallization at the solid/liquid interface will also be presented.