

ABSOLUTE ASYMMETRIC SYNTHESIS

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AKADEMISK AVHANDLING

för avläggande av filosofie doktorexamen i kemi som, med medgivande av Institutionen för kemi, Göteborgs universitet, kommer att försvaras offentligt fredagen den 9 oktober 2009 kl 13.15 i sal KC, Kemigården 4, Göteborgs Universitet och Chalmers tekniska högskola. Avhandlingen kommer att försvaras på svenska.

Fakultetsopponent är Docent Ola F. Wendt, Avdelningen för organisk kemi, Kemiska Institutionen, Lunds Universitet, Lund, Sverige.

ABSTRACT

Absolute asymmetric synthesis is the synthesis of optically active products from achiral or racemic precursors only. This has generally been regarded as impossible and is relevant in the discussion of the origins of biomolecular homochirality. A possible route to absolute asymmetric synthesis involves total spontaneous resolution, which is possible for stereochemically labile substances which crystallise as conglomerates (*i.e.* the enantiomers crystallise in separate crystals).

Using total spontaneous resolution it was, for the first time, possible to prepare bulk-quantities of configurationally labile five-, seven-, and nine-coordinate enantiomers, containing only achiral ligands. Previously, only four- and six-coordinate complexes have been prepared enantiomerically pure in bulk quantities. Spontaneous resolution of eight-coordinate complexes has also been reported. It was also possible to perform total spontaneous resolution of a diaryl sulphide, an octanuclear organo(oxo)zinc complex, and a diindenylzinc complex. In the case of a helical coordination polymer based on copper(I) chloride and triallylamine, it was found that repeated synthesis always yielded an excess of the same enantiomer, possibly due to the influence of cryptochirality.

It has previously been practically impossible to measure enantiomeric excesses in stereochemically labile microcrystalline samples. A method utilising quantitative solid-state CD spectroscopy has been introduced to solve this problem.

In the case of the chiral organometallic reagent di(3-picoline)di(1-indenyl)zinc, it was possible to perform reactions with *N*-chlorosuccinimide in the presence of methanol and *p*-benzoquinone yielding optically active stereochemically inert 1-chloroindene in high yield and high enantiomeric excess (up to 89% ee).

During the course of these studies, three cases of concomitant crystallisation of racemic and chiral phases have been discovered. This is a rare phenomenon of considerable interest *e.g.* in structure prediction.

The first synthetic route to well-defined hydridoalkylzincates is also reported.

Keywords: absolute asymmetric synthesis, enantioselective synthesis, chirality, optical resolution, spontaneous resolution, conglomerate, organozinc reagents, organometallic chemistry, coordination chemistry, supramolecular chemistry, intermolecular interactions

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