Giant ‘antichiral’ unit cell made of chiral columns

Paulina Rybak*, Adam Krowczynski, Jadwiga Szydlowska, Damian Pociecha and Ewa Gorecka

Faculty of Chemistry, University of Warsaw, ul. Zwirki i Wigury 101, 02-089 Warsaw, Poland
E-mail: prybak@chem.uw.edu.pl

New mesogenic materials, quinoxaline derivatives with semi-flexible cores have been studied and are reported to form new type of 3D columnar structure with large crystallographic unit cell and *Fddd* lattice below columnar hexagonal phase. The 3D columnar structure is a result of frustration imposed by arrangement of helical columns of opposite chirality into triangular lattice. Quinoxaline derivatives of lath-like shape may be stacked with random orientation leading to columns with overall circular cross-section, but might be also arranged into helical stacks. Helical arrangement of molecules along the columns is relatively often observed in columnar phases formed by molecules or molecular assemblies of non-perfectly circular geometry[1,2].

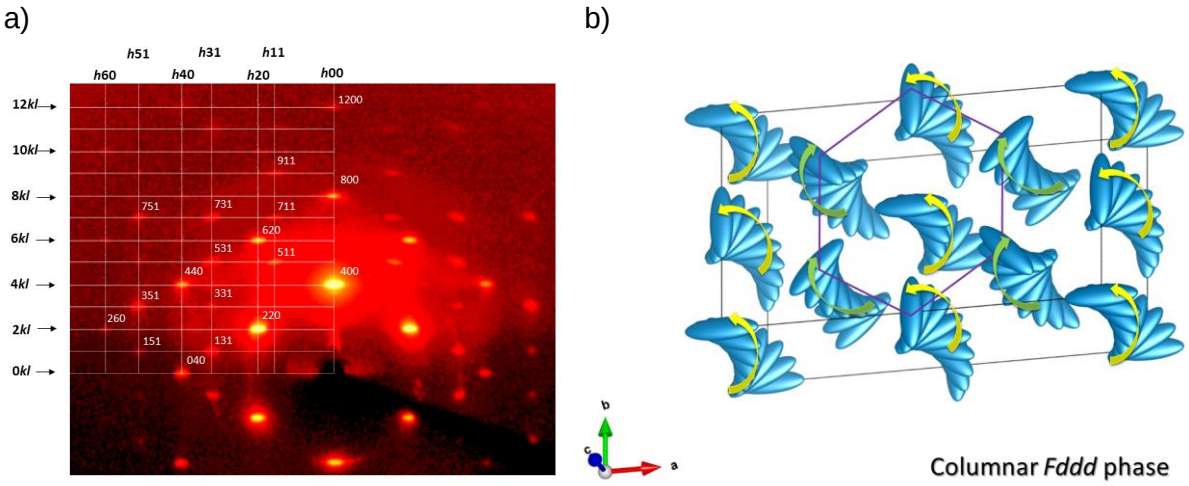

Figure 1. XRD pattern of Col_{Fddd} phase of one of the compound (a); model of the structure of columnar Col_{Fddd} phase built form helical columns with anisotropic cross section (b).

According to our studies the designed molecules with semi-flexible cores can form orthorombic structure with giant crystallographic unit cells. In temperature sequence apart from hexagonal lattice of columns columnar phase with *Fddd* symmetry was observed (Figure 1a). In this phase molecules twist along the column and to ensure good packing condition of elliptical objects the neighbouring helical columns exhibit opposite twist sense and are vertically shifted against each other, as a result the overall structure is ‘antichiral’. The phase symmetry is an interesting example of frustration provided by predisposition to sort the equivalent number of right- and left-handed columns into triangular lattice. Orthorhombic Col_{Fddd} phase is an example of symmetry breaking at nanoscale in achiral material.

References:

[1] M. Lehmann, M. Jahr and J. Gutmann, *J Mater Chem*, **2008**, 18, 2995-3003.
[2] V. Percec and Q. Xiao, *Israel Journal of Chemistry*, **2021**, 61, 530-556.