The Self-Assembly of Colloidal Titania Ribbons

Sébastien Boukhris[a], Mohamed Ibrahim[b], Mihaela Florea[c], Cyrille Hamon[d], Michel W. Barsoum[b] and Doru Constantin[a*]

a Institut Charles Sadron, CNRS and Université de Strasbourg, 67034 Strasbourg, France
b Department of Materials Science and Engineering, Drexel University, Philadelphia, United States
c National Institute of Materials Physics, 405A Atomiştilor Street, 077125 Măgurele, Romania
d Université Paris-Saclay, CNRS, Laboratoire de Physique des Solides, 91405 Orsay, France

ABSTRACT

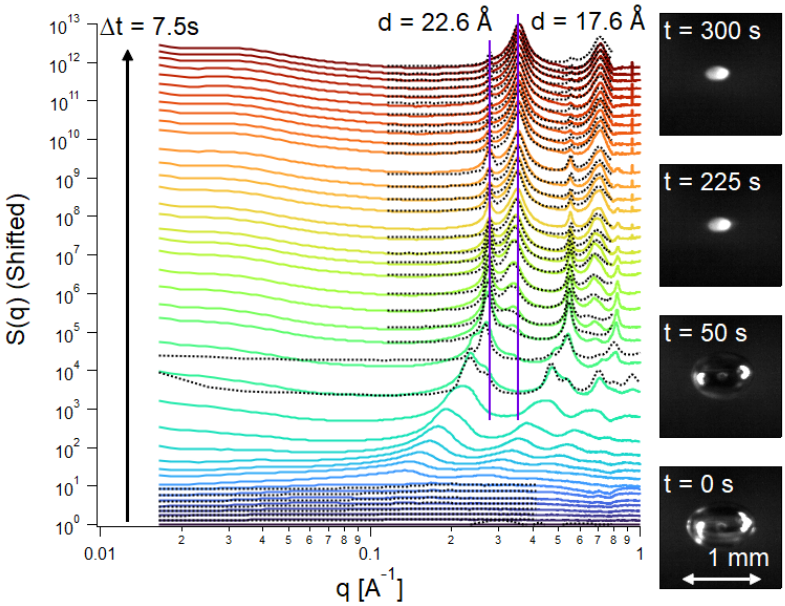
Titanium dioxide, TiO_2, is one of the most studied photocatalysts. Among TiO_2 nanostructures, recently-obtained 1D titanate lepidocrocite nanofilaments (NFs) are remarkable due to their very convenient (inexpensive, high-yield and environmentally friendly) synthesis strategy, but also exhibit fascinating structural and functional properties.[1]

We have recently shown that, in colloidal dispersion, the NFs loosely associate into ribbons, one lepidocrocite sheet thick (about 4 Å), 30 to 40 Å wide (5 to 8 NFs) and more than 300 Å long. After drying, their final state is that of extended sheets, stacked three to about twenty high, whose crystallinity increases with stack height.[2]

Our next goal is to follow in detail the evolution of the system as a function of concentration (in the colloidal state), allowing us to explore the phase diagram of this new family of colloidal objects. As the suspension dries, the kinetics of the stacking process becomes available.

First experiments, performed on levitated droplets (see the Figure) allowed us to quantify the interaction between ribbons and the resulting positional order within the dispersion, as well as their evolution during the drying process towards a final 3D crystalline state[3].

We will continue by studying in detail the morphology and internal degree of order within the ribbons and stacks. We will explore the role of the initial concentration, of the synthesis method, and of the nature of the solvent, which has been shown to influence profoundly the texture of the final material.[4]



REFERENCES

1. A. D. Walter et al., *ACS Nano* **19**, 4855-4866 (2025).
2. S. Boukhris et al., *Small Structures* **6**, 2500017 (2025).
3. S. Boukhris et al., in preparation.
4. G. R. Schwenk, A. D. Walter and M. W. Barsoum, *Nano Letters* **24**, 7584-7592 (2024).