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Nanometer-scale control of the crystallization of oligomers and polymers.

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The ability to control the position and local orientation of organic crystals at the nanometer scale paves the way to the fabrication of hybrid nano-devices displaying better properties. Here, we present two ways to control the assembly of organic chain compounds into nanometric crystals of defined location or orientation. We first show how the location of crystals of model oligomers can be directed by chemical nano-templates [1]. The templates are obtained by combining electron-beam lithography with the deposition of self-assembled monolayers [2]. These surfaces can then be used to control a variety of assembly processes [3], such as the crystallization of model alkane-1-ol oligomers in solution. By using directing maps with the appropriate chemical inks, nano-squares, nano-corrals and nano-lines of organic crystals are rapidly and massively grown at pre-defined locations, at least down to 60 nm. At this scale, confinement effects mediated by van der Waals forces become prominent, providing a unique handle to design crystal growth. Then, we show how the nucleation and orientation of polymer crystals can be controlled by nano-imprint lithography [4]. The combination of confinement, and of preferential nucleation at the vertical walls of the nano-molds probably arising from partial chain orientation due to the polymer flow during embossing, results in local control over the 3D orientation of the crystals. We demonstrate that crystals may be guided through complex geometries, and investigate the case of systems where conflicting instructions are delivered to the crystallizing chains.

References:

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