A Cross-shaped Monomer as Building Block for Molecular Textiles

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Textiles, material consisting of 2D interwoven yarns and threads, are an exceptional class of materials due to their flexibility, stability and shape adaptability. [1,2] These extraordinary properties generate a desire to mimic these materials on molecular scale. In the last decade several routes have been explored to interweave 1D linear polymers in order to obtain a molecular 2D textile. [3,4] Using a surface metal organic framework approach by Wang *et al*., and utilizing a 9 fold-metal complex by August *et al*., have shown promising results but also the challenges and complexity related to the synthesis and analysis of such highly ordered 2D molecular structures. In our research a new route is explored where pre-organization at the water surface plays a key-role in forming the envisioned 2D material. Our approach is designed bottom up, where the textile can be visualized as a structure consisting of an infinite amount of small cross-shaped motives (Fig 1). Assembling and pre-organize these repeating units at the water surface would allow to bring them in close proximity and link them together in 2D fashion. The thereby obtained network consists of covalently interlinked yarns, which after cleavage yield an only physically interwoven molecular textile.

The designed building block, depicted in Figure 1 (right), consists of two *ortho*-tetraphenylene units interlinked by two ester bonds. This chemical feature gives rise to the required static and dynamic control – the 3D cross-shaped conformation prevents intramolecular reactions, while the reversible nature of the ester bond allows cleaving them in the final step separating the yarns. Asymmetric functionalization of the building block via single sided introduction of hydrophilic R-groups yields an amphiphilic molecule enabling preorganization at the water air interface. The pre-organized self-assembled molecules can then undergo a directed Schiff base polycondensation yielding a cross-linked 2D network. The 3D conformation and amphiphilic character of the building block will force the monomers to link 'top' and 'bottom' of neighboring ones, creating the interwoven character of a textile.

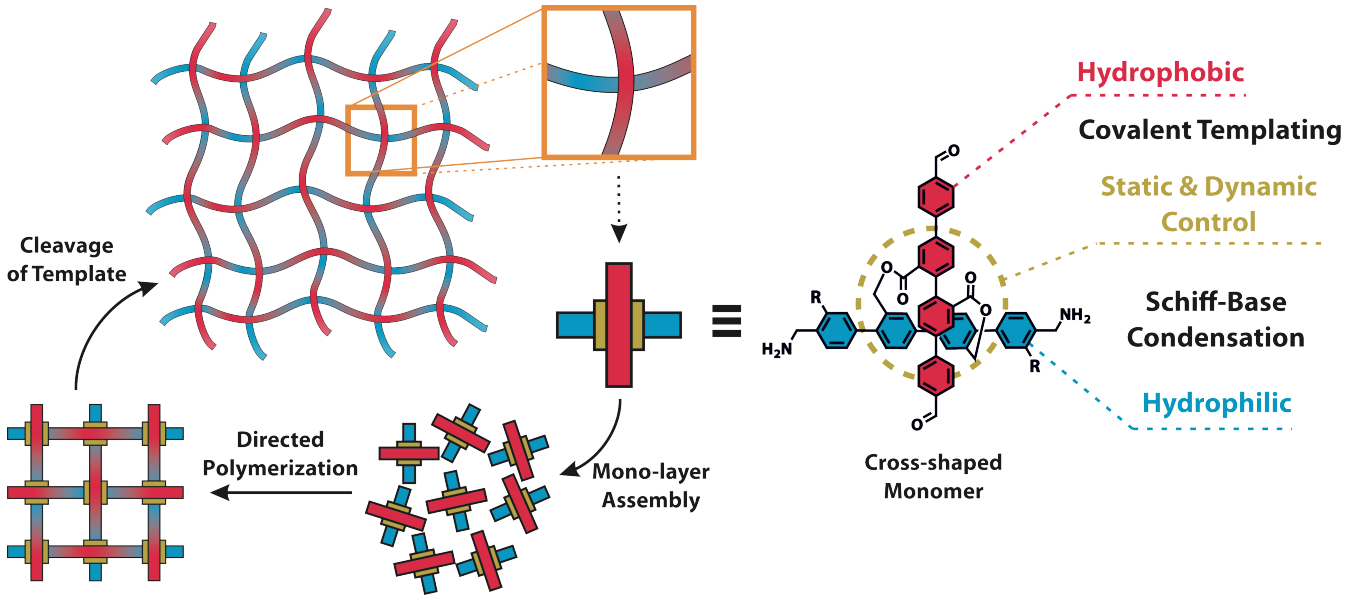

Figure 1: *left) Schematic representation of bottom-up approach right) Molecular Design of Cross-shaped monomer.*

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