Bioinspired supramolecular assemblies to probe the effect of chirality on cell migration

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Chirality is ubiquitous in Nature, down to the molecular scale as exemplified by the DNA double helix and the collagen triple helix. At the supramolecular scale, chirality influences functions that involve recognition processes. For instance, it has been shown that the chiral interaction of specific myosin proteins with the actin cytoskeleton is key in the symmetry breaking at all biological scales, up to the motion of the organisms.[1]

Inspired by biomolecular constructs, our group has harnessed various types of sequence-defined (bio)macromolecules to shape chiral supramolecular assemblies for potential applications in health and materials sciences.[2-4] In this communication, we report on the design of bioinspired assemblies in view of studying the role of matrix organization and chirality on the cellular behavior.

First, we report on the design of peptides that self-assemble to mimic the structure of collagen, which is an essential constituent of the extracellular matrix. We study the chiroptical properties and microscopic morphology of tailored peptides containing either L or D amino acids, in solution and on surfaces. The peptide self-assemblies on surfaces are utilized to assess the role of chirality on cell-matrix interactions. Remarkably, we observe that the spreading and the migration speed of epithelial keratocyte cells are different on mirror-image surfaces. By using molecular modeling, we discuss how the chirality at the molecular and supramolecular levels can effectively influence cell migration via the interactions between the self-assembled peptides and a specific integrin.[5] Then, we report our latest results on the design and characterization of DNA-based assemblies utilized to develop stimuli-responsive hydrogels. Globally, these studies show the potential of our supramolecular approach to probe important biological processes such as cell migration and differentiation.

References

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