Enhanced chiroptical activity with dielectric chiral nanostructures: applications in racemic-mixture sensing

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The concept of chirality, related to objects and structures which present non-superimposable mirror images – also known as enantiomers - in any plane of symmetry, has attracted a lot of attention recently. Chirality is deeply related to life sciences, where for example, it has been suggested as the underlying cause of Parkinson's and Alzheimer's diseases [1]; and in particular, the pharmaceutical sector, where single-enantiomer drugs are being developed to improve their effectiveness and compatibility [2]. Regarding optical research, chirality is an appealing topic due to the different absorption that chiral molecules present to circularly polarized light, a phenomenon called Circular Dichroism (CD), which is exploited for enantiomer recognition and separation.

However, regular CD effects are very weak, so chiral nanoantennas have been introduced to amplify the chiroptical activity [3]. The use of such metamaterials allows for CD signal enhancement in the far field, while in the near field enhancement of Kuhn's dissymmetry factor is sought. Furthermore, in order for the near field-enhancement to couple with the enhanced far field signal, structures which present molecule-available dissymmetry hotspots in the vicinity of the structure are also appealing [4].

In this work we propose a novel dielectric chiral nanostructure capable of offering both near and far field chirality enhancements, while presenting high-dissymmetry areas available to analytes. We also demonstrate how this structure can act as unit cell to engineer a metasurface able to act as a chiral plasmonic directional sensor.

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