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Superchiral Near Fields in Photonic Crystal Waveguides

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Abstract Highly accurate sensing of chiral molecules is crucial in drug development as one mirror image of a chiral molecule (enantiomer) can be toxic while the other is healing. The rate of absorption for a chiral molecule is different for left- and right-handed circularly polarized light (LCPL, RCPL), and this interaction asymmetry can be used to probe chirality. This interaction asymmetry is typically very weak, but it can be enhanced when light becomes superchiral [1], i.e. the field has an optical chirality (C) that is larger than that of circularly polarized light. Here we show that a conventional silicon photonic crystal waveguide (PhCW) has a near field with superchiral hotspots and we propose to use this superchirality to make an on-chip sensing device. A conventional PhCW has a zero net optical chirality, as the optical chirality is antisymmetric in every mirror plane and conventional PhCWs have several mirror symmetries. The symmetries were broken by shifting the rows of holes closest to the waveguide. The resulting chiral PhCW and a conventional PhCW are shown in Fig. 1. The near fields of this chiral PhCW exhibit superchiral hotspots far stronger than that of the conventional one, and the net chirality is nonzero.

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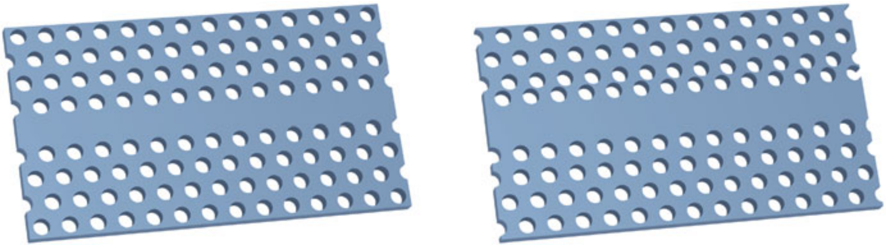

Fig. 1 A regular PhCW (left), and a symmetry-broken or chiral PhCW (right)

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