Polarization Effects in Microcoil Resonators

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Abstract: Optical microcoil resonators (OMRs), formed by coiling a micron-diameter fibre around a rod as shown in Figure 1a, provide a unique resonator geometry in which light can evanescently couple between adjacent turns to produce high Q resonances. Furthermore, OMRs fabricated from a pigtailed fibre taper offer much lower coupling losses than cavity resonators. Applications in fields such as fluidic and temperature sensing have already been investigated, and the small fibre diameter and effective modal area indicate that OMRs are a promising platform for studying nonlinear interactions. A detailed understanding of OMR optical characteristics is crucial for further development, but theoretical studies [1,2] have thus far neglected any polarization dependency. In this work, the influence of the fibre's birefringence on the polarization of propagating light was studied by numerically solving polarization-dependant coupled mode equations. The resulting transmission and dispersion properties are discussed for different degrees of fibre twist (Figure 1b). In addition to the linear behaviour, the nonlinear regime was explored, by incorporating a Kerr term, and found to be strongly enhanced around resonances.

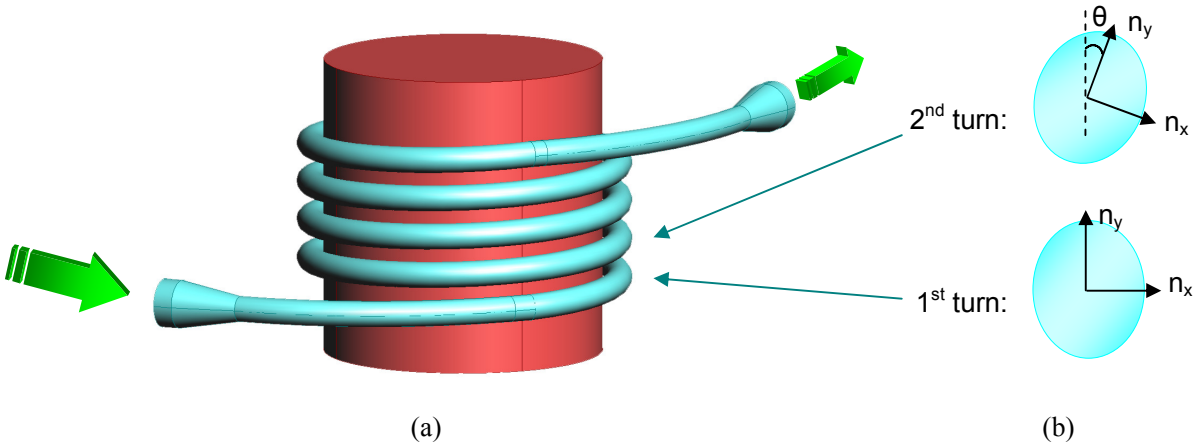

Figure 1: (a) Microcoil structure, and (b) the birefringent axes of adjacent turns when the fibre is twisted through angle θ.

References

[1] M. Sumetsky, "Uniform coil optical resonator and waveguide: transmission spectrum, eigenmodes, and dispersion relation," Opt. Express **13**, 4331-4340 (2005).

[2] N. G. R. Broderick, "Optical Snakes and Ladders: Dispersion and nonlinearity in microcoil resonators," Opt. Express **16**, 16247-16254 (2008).