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TWISTED OPTICAL AND MICROWAVE NEAR FIELDS FOR PROBING CHIRALITY OF BIOLOGICAL STRUCTURES

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A large fraction of biological molecules are chiral, the chemistry of life is built almost exclusively on left-handed amino acids and right-handed sugars, a phenomenon that is known as the homo chirality of life. Despite the importance of chiral molecules, the experimental determination of enantiometric excess, the fraction of left- versus right-handed molecules within a mixture of chiral molecules remains a tremendous challenge. Nowadays, localized measuring of chirality of biological and artificial-material structures is mainly a prerogative of optics. In optics, chiral discrimination for biosensing and chiral-material characterization is represented in a larger variety of effective tools. For biomedical diagnostics and pathogen detection, special plasmonic structures with left- and right-handed optical superchiral fields have been recently proposed. These structures effectively interact with large biomolecules, in particular, and chiral materials in general. Microwave techniques are attractive for biological applications because of their sensitivity to water and dielectric contrast. Due to the growing interaction between biological sciences and electrical engineering disciplines, effective microwave sensing and monitoring of biological samples is an important subject. It becomes sufficiently apparent that in microwaves, the problem of effective chirality characterization of chemical and biological objects can be solved when one develops sensing devices with microwave chiral probing fields. Can one use the main ideas and results of the optical subwavelength chiral-field photonics to create microwave structures with subwavelength chiral-field confinement? Since resonance frequencies of electrostatic (plasmon) oscillations in small particles are very far from microwave frequencies, an answer to this question should be negative. Nevertheless, there exists another type of microwave structures, which show strong subwavelength localization of electromagnetic energy and unique field topology. There are small ferrite particles with magnetostatic-magnon oscillations. Recent studies in Microwave Magnetic Laboratory, BGU show that near fields originated from small ferrite-disk particles with such oscillations are microwave twisted fields. The obtained microwave chiral-field structures can provide unique insights for biomedical diagnostics and pathogen detection.

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