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題目:Three-dimensional near-field analysis of metal nanostructures

概要:Chirality is the property that an object or a system can be distinguished from its mirror image. In nature, there are a lot of chiral molecules closely associated with life that are crucial in chemistry and biology. Such molecules and their enantiomers have so similar physical properties that it is very difficult to separate them. To solve this problem, their optical properties have been focused. The chiral molecule and its enantiomer exhibit each different response to a circularly polarized light. This phenomenon is called optical activity, e.g., optical rotation (OR) and circular dichroism (CD). However, these optical signals are typically small. It is considered to be caused by mismatch between the light wavelength and the size of the molecule. Recently, it is demonstrated that chiral molecules on a plasmonic metal nanostructure [1] exhibit much larger CD signals [2]. In these reports, it is assumed that the nanoscale chiral field on the metal nanostructure strongly interacts with the molecules. Here, we investigate the electric field of the surface of the metal nanostructure three-dimensionally. The structure under consideration is the achiral rectangular gold nanostructure that shows no optical activity in the far-field, but exhibits clear local CD signals [3]. We numerically demonstrate that the strong chirality appears not only in the in-plane electric field but also in the longitudinal vertical field. In particular, the latter is difficult to measure with aperture-type scanning near-field optical microscope. The intensity of the longitudinal field at the corners is increased up to 12.5 times of the incident field intensity. This implies the necessity of the three-dimensional near-field measurement of chiral plasmonic or other metal nanostructures for evaluating the chiral plasmonic interaction between the metal and the molecule.

References

- 1) M. Kuwata-Gonokami, et al., Phys. Rev. Lett., 2005, 95, 227401.
- 2) E. Hendry, et al., Nat. Nanotech., 2010, 5, 783.
- 3) S. Hashiyada, et al., J. Phys. Chem. C, 2014, 118(38), 22229.

感想:会議参加の感想など:英語での発表は慣れませんでした、海外の方から意見もいただき有意義なものとなりました。プラズモンに詳しいマルベリー教授などがおり、関連する内容の講演を聞いたこと、その他良い経験が得られました。