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(G*) Microwave hotspots in resonantly-coupled aqueous dimers

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The intense confinement of electromagnetic fields between metallic bispheres remains a subject of ongoing technological interest. Similarly, light can be concentrated into near-flied subwavelength hotspots in dimers of high refractive index dielectric resonators. Micro-resonators made of silicon and germanium are often exploited in forming exceedingly strong axial hotspots in dimers at visible spectrum region, facilitated by the hybridization of morphology-dependent resonances (MDRs) in individual objects. With an index of refraction approaching 9 at microwave frequencies, water has a large index contrast between the dielectric and the surrounding air, making water a particularly suitable material for obtaining strong Mie resonances. As a result, cm-sized aqueous dielectric dimers such as grapes can exhibit sufficiently strong axial hotspots to ignite plasma within household microwave ovens. Since individual grapes are never observed to spark, an understanding of the hybridization of isolated MDRs in dimers (and clusters) is of interest from a fundamental and technological (nano)photonic perspective.

We employ a combination of experimental, analytical, and computational methods to investigate MDRs hybridization in water, with a focus on the formation of axial hotspot in aqueous dimers. Experimentally, we use hydrogel beads and thermal imaging to explore polarization and size-dependence in hybridization. An analytical approach of applying vectoral addition of spherical harmonics provides geometric insight into which modes most strongly interact to form an electromagnetic hotspot. Finally, we employ the FEM simulations to further investigate mode concentrations and hotspot formation in dimers of various sizes, orientations, and separation.

Keyword-1

MDR

Keyword-2

Microwave

Keyword-3

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