

Study on scaling properties of the Menger sponge by LCAO approximation

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So far, we reported accurate calculation of the frequency and quality factor of localized electromagnetic eigenmodes in the dielectric Menger sponge fractal [1] and showed that the 90-degree light scattering is much superior to transmission/reflection measurements to detect the localized modes [2]. We also showed the presence of localized modes in the metallic Menger sponge although their quality factors are not very large [3].

In this study, we examine the scaling law of the eigenfrequency and field distribution for the metallic Menger sponge of stage 1 to 3. We show that the LCAO approximation is a good approximation due to the localized nature of the eigenmodes and it gives a guiding principle for the analysis of scaling properties.

[1] K. Sakoda, *Physical Review B*, **72**, 184201 (2005).

[2] K. Sakoda, *Optics Express*, **13**, 9585 (2005).

[3] K. Sakoda, *Laser Physics*, **16**, 897 (2006).

[4] K. Sakoda, *Optics Express*, **14**, 11372 (2006).