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Mathematical analysis of the photo-acoustic imaging modality using resonating dielectric nano-particles: the $2D$ TM-model. (English) Zbl 1478.92101

J. Math. Anal. Appl. 506, No. 2, Article ID 125658, 64 p. (2022).

In this paper, the focus is on the photoacoustic imaging modality using dielectric nano-particles as contrast agents.

A heterogeneous tissue is considered, and represented by a bounded domain Ω. By means of an electromagnetic wave, heat is generated, and consequently an acoustic pressure wave, that can be detected and measured on the accessible boundary $\partial\Omega$. This allows to extract information about optical properties of the tissue.

Two different studies are carried out, according as single nano-particles, or couples of closely spaced nano-particles (i.e. dimers), are injected.

From the measure of the acoustic pressure before and after the injection process, the authors are able to localize the center points of the nano-particles previously injected.

This leads to transform the photoacoustic problem into the inversion of phaseless internal electric fields in the first case, while, in the second case, the permittivity and the conductivity of the tissue on the centers is obtained.

A comparison is provided with authors' knowledge about the photo-acoustic imaging modality using contrast agents

Reviewer: Paolo Dulio (Milano)

MSC:

92C55 Biomedical imaging and signal processing
78A70 Biological applications of optics and electromagnetic theory
78A46 Inverse problems (including inverse scattering) in optics and electromagnetic theory
35R30 Inverse problems for PDEs
35Q60 PDEs in connection with optics and electromagnetic theory

Keywords:

dielectric resonance; inverse problem; nano-particle; photo-acoustic imaging

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