Homogenization of a carcinogenesis model with different scalings with the homogenization parameter

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In the context of periodic homogenization based on two-scale convergence, we homogenize a linear system of four coupled reaction-diffusion equations, two of which are defined on a manifold. The system describes the most important subprocesses modeling the carcinogenesis of a human cell caused by Benzo-[a]-pyrene molecules. These molecules are activated to carcinogens in a series of chemical reactions at the surface of the endoplasmic reticulum, which constitutes a fine structure inside the cell. The diffusion on the endoplasmic reticulum, modeled as a Riemannian manifold, is described by the Laplace-Beltrami operator. For the binding process to the surface of the endoplasmic reticulum, different scalings with powers of the homogenization parameter are considered. This leads to three qualitatively different models in the homogenization limit. We illustrate the results by numerical simulations.

References

[1] *I. Graf*: Multiscale modeling and homogenization of reaction-diffusion systems involving biological surfaces. PhD dissertation, Universität Augsburg (2013), Logos Verlag Berlin.