



**Multiscale modeling and homogenization of
reaction-diffusion systems involving biological
surfaces (Augsburger Schriften Zur Mathematik,
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Isabella Graf

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Isabella Graf

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Many complex chemical processes are responsible for the proper functioning of the human body. A prime example is the finely structured endoplasmic reticulum, which plays an important role in the metabolisms of human cells. To handle mathematical models that account for this fine structure, periodic homogenization methods are derived and applied. Previous results on homogenization of partial differential equations on finely structured manifolds are extended: Using the periodic unfolding method, diffusion terms on manifolds with different scalings with powers of the homogenization parameter, in particular in case of fast diffusion, are homogenized and are applied in three different biological systems: a linear model of carcinogenesis of cells, a nonlinear extension of the linear carcinogenesis model and a model considering T-cell signaling. Simulations and interpretations of the homogeneous T-cell signaling model give an insight into the related biological mechanisms.

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