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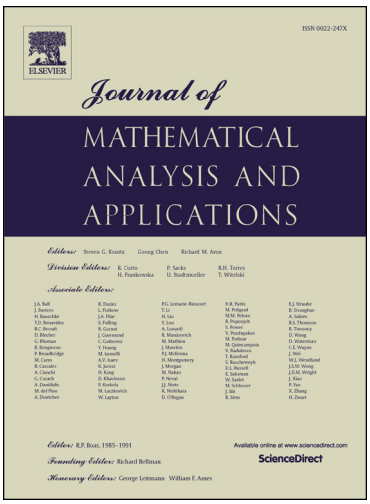

On the asymptotic limit of the effectiveness of reaction–diffusion equations in periodically structured media

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On the asymptotic limit of the effectiveness of reaction-diffusion equations in periodically structured media

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Abstract

This paper addresses an investigation of the asymptotic behaviour as $\varepsilon \to 0$ of the solution to the boundary value problem associated with the p-Laplace operator in an ε-periodically structured domain with a nonlinear Robin-type condition specified on the boundary of the periodic subdomains. This kind of domains include the so called perforated media as well as the case of isolated particles distributed in a periodic way. This second case arises quite often in Chemical Engineering. Here we consider a non-critical size of the particles. The objective of this paper is twofold. First we study the homogenization of solutions in the case of a continuous nonlinear reaction term on the boundary of the periodic structure.. Then, we move to studying the homogenization of the effectiveness factor of the reactor, which is of relevance in Chemical Engineering.

Keywords: homogenization, p-Laplace diffusion, non-linear boundary reaction, non-critical sizes, effectiveness factor

2010 MSC: 35B25,35B40,35J05,35J20

Introduction

We will study asymptotic behaviour as $\varepsilon \to 0$ of the solution to the boundary value problem associated with the p-Laplace operator in an ε-periodically structured domain with a nonlinear Robin-type condition specified on the boundary of the periodic subdomains. This kind of domains include the so called perforated media as well as the case of isolated particles distributed in a periodic way. This second case arise quite often in Chemical Engineering. Here we consider a non-critical size of the perforations or particles.. The objective of this paper is twofold. First, a homogenized problem is constructed and a theorem is proved stating weak convergence as $\varepsilon \to 0$ of the solution of the original problem to the solution of the homogenized one. The closest papers in the literature are [31, 32] where the case $p = 2$ was considered, [17, 18, 19, 26] dedicated to the case $2 < p < n$ and [11] where the case $p > n$ was

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