Homogenization in perforated domains with Fourier boundary conditions

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We deal with the asymptotic analysis of a variational problem for a functional defined in a perforated medium and combining the bulk (volume distributed) energy and the surface energy defined on the perforation boundary. In the studied model the perforation is obtained by a homothetic dilatation of a given periodic structure of holes, with a small scaling factor denoted by ε. Then the surface measure tends to infinity as ε goes to 0. To compensate this measure growth we assume that the mean value of surface energy as function of the independent variable is equal to zero. Then we show that the said functional has a nontrivial Γ-limit for which we provide a representation formula in terms of of an auxiliary variational problem on the perforated torus. It is worth to note that, in contrast with the case of linear partial differential equations studied in [1], the contributions of the bulk and surface energies to the limit Lagrangian are coupled. Also, we study the asymptotic behaviour of the corresponding minimization problems, and show that, if the coercivity constant of the bulk energy is large enough, the minimal energies and minimizers of the ε-variational problems converge to those of the limit functional. The results have been obtained in collaboration with A. L. Piatnitski, and represent a nonlinear generalization of [1].

References

[1] Belyaev, A. G.; Piatnitski A. L.; Chechkin G. A. *Averaging in a perforated domain with an oscillating third boundary condition.* (Russian) Mat. Sb. 192 (2001), no. 7, 3–20; translation in Sb. Math. 192 (2001), no. 7-8, 933–949