STOKES EQUATION, SCALING, DARCY LAW AND SMOLUCHOWSKI FLOW

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We describe flow of a incompressible fluid – electrolyte through a porous dielectric medium in frame of the Stokes equation. Natural jump conditions are assumed on the interfaces between the porous skeleton and the fluid in such composite. By using the method of 2-scale asymptotic expansions, the macroscopic phenomenological equations describing such a structure are derived and the formulae for the effective coefficients are given.

The system we are dealing with posseses 2 spacial scales ℓ (dimension of a pore) and L (dimension of the whole composite), related by a fraction $\varepsilon = \ell/L$. Depending on scaling of the viscosity coefficient different results are obtained. Scaling with ε^2 coefficient leads to the Darcy law, while without scaling (ε^0) the Smoluchowski formula for electrolyte flow is recovered, conditioned by zeta-potential of electric double layer (EDL). We observe that the pressure is not constant along the depth of the EDL.

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