Transport in Stochastic Media

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Classical transport of neutral particles in a binary, scattering, stochastic media is discussed. It is assumed that the cross-sections of the constituent materials and their volume fractions are known. The inner structure of the media is stochastic, but there exist a statistical knowledge about the lump sizes, shapes and arrangement.

The transmission through the composite media depends on the specific heterogeneous realization of the media. The current research focuses on the averaged transmission through an ensemble of realizations, from which an effective cross-section for the media can be derived.

The problem of one dimensional transport in stochastic media has been studied extensively [1]. In the one dimensional description of the problem, particles are transported along a line populated with alternating material segments of random lengths.

The current work discusses transport in two-dimensional stochastic media. The phenomenon that is unique to the multi-dimensional description of the problem is obstacle bypassing. Obstacle bypassing tends to reduce the opacity of the media, thereby reducing its effective cross-section. The importance of this phenomenon depends on the manner in which the obstacles are arranged in the media.

Results of transport simulations in multi-dimensional stochastic media are presented. Effective cross-sections derived from the simulations are compared against those obtained for the one-dimensional problem, and against those obtained from effective multi-dimensional models, which are partially based on a Markovian assumption.

[1] F. Malvagi, G. C. Pomraning, "A Comparison of Models for Particle Transport Through Stochastic Mixtures", Nucl. Sci. Eng. 111,215 (1992)