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Fractal model of gas diffusion coefficient through porous nanofibers with rough surfaces

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Fractal model of gas diffusion coefficient is derived for porous nanofibers, which are assumed to be composed of a bundle of tortuous capillaries whose pore size distribution and roughness of wall surfaces of capillaries follow the fractal scaling laws. The analytical expression for gas relative diffusion coefficient is a function of the relative roughness, fiber radius and microstructural parameters (porosity, the fractal dimension for pore size distribution and tortuosity, the maximum and minimum pore diameter and the characteristic length). The proposed fractal model is validated by comparison with available experimental data and correlations. At the same time, the effect of microstructural parameters of porous nanofibers on gas diffusion has been studied in detailed. The results show that roughness of wall surfaces of capillaries in porous nanofibers should not be neglected. It is believed that the current work can reveal gas diffusion mechanism in porous nanofibers and may be applied in other porous materials.

References

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