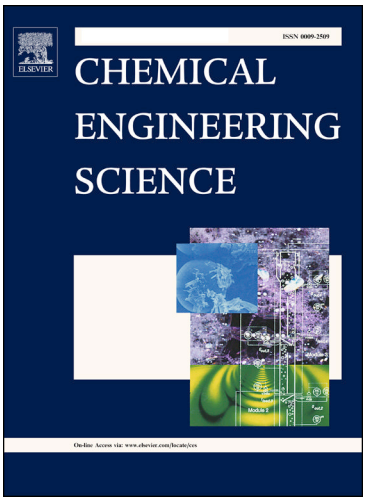

Fractal analysis of the effect of rough surface morphology on gas slip flow in micro- and nano- porous media

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Fractal analysis of the effect of rough surface morphology on gas slip flow in micro- and nano- porous media

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Abstract

Gas slip flow in micro- and nano- porous media with rough surfaces is investigated by the fractal geometry theory with a focus on the effect of surface roughness of capillaries. Based on the assumption that the pore size distribution of the porous media and rough elements of the wall surfaces of capillaries follow the fractal scaling law, apparent gas permeability and gas slippage factor are derived. According to the Klinkenberg equation, the key to the calculation of apparent gas permeability is the determination of gas slippage factor. In this paper, we established an analytical relationship between the gas slippage factor and the structural parameters of porous media. We first validated the model with available experimental data, then analyzed the effect of the relative roughness, porosity, the tortuosity fractal dimension and the pore fractal dimension on the gas slippage factor. With our fractal model, the physical mechanisms of gas slip flow are better elucidated.

(Remarks: sentences with blue in this revised manuscript indicate that they are revised or newly added.)

Keywords: fractal; slip flow; roughness; micro- and nano- porous media

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