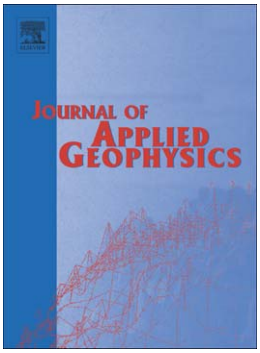

Experimental investigation on variation of physical properties of coal particles subjected to microwave irradiation

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Experimental investigation on variation of physical properties of coal particles subjected to microwave irradiation

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Abstract: The gas drainage rate of low-permeability coal seam is generally low. This leads to the gas disaster of coal mine, and largely restricts the extraction of coalbed methane (CBM), and increases the emission of greenhouse gases in the mining area. Consequently, enhancing the gas drainage rate for a coal seam is an urgent challenge to be solved from the viewpoint of the exploitation of CBM. To solve this problem, the new approach of using microwave irradiation (MWR) as a non-contact physical field excitation method to enhance gas drainage from a coal seam has been attempted. In order to evaluate the feasibility of this method, the methane adsorption, diffusion and penetrability of coal subjected to MWR was experimentally investigated in this study. Thus, the variation of methane adsorbed amount, methane diffusion speed and absorption loop for the coal sample before and after MWR were obtained. The findings show that the MWR can change the adsorption property of coal, and reduce the methane adsorption capacity of coal. Moreover, the irradiated coal samples and that original coal samples have the methane diffusion characteristic curves with a same trend. The irradiated coal samples have better methane diffusion ability than the original samples. As the adsorbed amount of methane for the coal samples decreased, the sample subjected to MWR had increased or equal methane diffusion speed. Furthermore, compared to the original coal samples, the area of absorption loop for those irradiated samples increases, especially for the micro-pore and medium-pore stage. This leads to the increase of proportion of open pores for coal sample, thus improving the gas penetrability of coal sample. From the above, this indicates the modification effect of the MWR on coal, causing pore structure variation in coal particles, thereby changing the methane adsorption, the methane diffusion and the gas penetrability properties of coal particles.

Keywords: Microwave irradiation; coal particles; adsorption; diffusion; gas penetrability; coalbed methane

1 Introduction

The gas in a coal seam is also called coalbed methane (CBM), and it is a clean and efficient energy source. It can be used as an alternative energy source for coal, petroleum, and natural gas (Karacan et al., 2011). However, the main component of coal seam gas is methane, disasters such as gas explosion and coal and gas outburst can be caused during coal mining and seriously affect the safety of coal mines. In addition, methane is also a potent greenhouse gas (Bibler et al., 1998; Saghafi

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