

Creation of Micro Channels in Bowen Basin Coals Using UV Laser and Reactive Ion Etching

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Abstract

We report a set of techniques to create micro channels (20-40 μm) in Bowen Basin coals for use as experimental models with replicate characteristics of natural cleats under sub-surface reservoir conditions. The model cleats were developed to allow systematic laboratory investigations of water and gas relative permeability behaviour in coal seam gas reservoirs. The four cleat fabrication techniques evaluated were UV laser, reactive ion etching in oxygen plasma (RIE), mechanical scratching with a tungsten carbide cutting tool and chemical etching with KMnO_4 .

The UV laser and RIE methods both produced channels that met the width, depth and shape criteria, and micro-Raman spectroscopy indicated that these etching methods did not induce significant chemical changes on the coal surface. Soft-lithography molds and SEM show that the morphology of the walls in the RIE channel more closely resemble a natural cleat, but the walls of the laser etched channel were much smoother than a natural cleat. The mechanical and chemical methods were eliminated from the study early, as these methods did not produce channels with the desirable physical characteristics. Two-phase flow of water and gas bubbles in the UV laser and RIE channels was demonstrated in a microfluidic device.