Evaluating the fracture morphology of shale specimen by the means of AE power spectrum characteristics

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Quantitative evaluation of the fracture morphology of shale is an essential prerequisite for assessing the complexity of hydraulic fracturing fracture networks during shale gas exploitation. Brazilian tests coupled with digital image correlation and acoustic emission technique were conducted on black shale in Sichuan Basin in China, the corresponding relationships between the characteristics of the frequency band of acoustic emission power spectra and the micro-damage mechanism of rock specimens were established, and the fracture morphology was quantitatively evaluated. The bedding layer leads to the differences in power spectra characteristics, micro-damage mechanism and fracture morphology of shale. The tension and shear failure of shale matrix induce high-frequency acoustic emission signals, and the tension and shear failure of shale bedding induce low-frequency acoustic emission signals. With the increase of the angle between the bedding layer and loading direction, the dominant frequency and secondary dominant frequency gradually diffuse from low-frequency band to high-frequency band, and the quantitative ratio of high frequency to low frequency H:L gradually increases. The H:L of 0° shale specimen is 4.28%: 95.72%, and the fracture is a straight line in shape. The H:L of 30° and 60° shale specimens are 15.89%: 84.11% and 36.93%: 63.07% respectively, and their fractures are arched in shape. The H:L of 90° specimen is 93.85%: 6.15%, and the fracture is composited arc-straight line in shape. The results can provide references for analyzing micro-seismic data in situ, and provide a theoretical basis for controlling fracture trajectory in hydraulic fracturing in shale reservoirs.