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论文

煤样破裂表面电位多重分形特征

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摘要:

为深入分析煤样受载破裂机制, 试验研究了煤样单轴压缩下表面电位变化规律, 应用多重分形统计理论分析表面电位信号, 计算其多重分形谱, 并分析多重分形谱特征参数随加载过程的变化规律。研究表明: 煤样表面电位信号存在多重分形特征, 在较大尺度内满足标度不变性; 不同尺寸的试样, 表面电位信号多重分形谱呈右钩状; 多重分形谱特征参数 $\Delta\alpha$ 和 Δf 的变化规律与试样受载变形破裂过程具有良好的对应关系, $\Delta\alpha$ 和 Δf 经过较长时间平稳升高后迅速下降的趋势改变可以作为破裂的前兆信息, 对试样失稳进行提前预警。

关键词: 表面电位; 时间序列; 多重分形谱; 特征参数

Multi-fractal characteristics of surface potential of coal during the fracture

Abstract:

In order to analyze the failure mechanism of coal under the load, multi-fractal characteristics of surface potential of coal sample under uniaxial compression was studied. The surface potential was analyzed using multi-fractal theory to calculate the multi-fractal spectrum. The change rules of characteristic parameters of multi-fractal spectrum with the loading process were studied. The results show that the surface potential represents multi-fractal feature, and keeps scale invariance in the wide range. The shape of the multi-fractal spectrum of different size specimens shows right hook. The characteristic parameters of multi-fractal spectrum, $\Delta\alpha$ and Δf , vary with the process of deformation and fracture of coal sample with load. The changes of trend that $\Delta\alpha$ and Δf increase in a long time, then decrease rapidly can be used as a precursory factor of coal-rock failure to forecast the instability of the samples. The results are helpful to understand the inherent law in the coal specimen failure process and forecast the dynamic disaster using the potential.

Keywords: surface potential; time series; multi-fractal spectrum; characteristic parameter

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