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工程热物理

黄铁矿燃烧时亚微米颗粒物的生成特性

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摘要： 将纯黄铁矿在O2/N2与O2/CO2条件下进行沉降炉燃烧实验，采用低压撞击器(dekati low pressure impactor，DLPI)收集燃烧生成的亚微米颗粒物(PM1)，并获得质量粒径分布。利用X射线荧光能谱仪(X-ray fluorescence，XRF)和配备了能谱仪的环境扫描电子显微镜(scanning electron microscope equipped with energy dispersive X-ray spectrometer，SEM- EDS)对PM1的物化特性进行深入表征，研究黄铁矿在不同燃烧气氛下所生成的PM1的质量粒径分布、浓度、元素组成、形貌和成分特性。研究结果表明，黄铁矿燃烧对PM1的生成具有重要贡献。相同O2浓度时，相比于O2/N2燃烧条件，O2/CO2燃烧条件下黄铁矿燃烧过程中PM1的生成量与峰值粒径均减小。在O2/N2或O2/CO2燃烧条件下，随着O2浓度的增加，PM1的生成量与峰值粒径呈增大趋势。PM1的组成主要以S元素为主。在O2/N2燃烧条件下，O2浓度对不同含S化合物的分布具有重要影响，在低O2浓度下，PM1中的S元素主要以S单质的形式存在，而在高O2浓度下，PM1中的S元素主要以硫酸或硫酸盐的形式存在。

关键词： 黄铁矿 亚微米颗粒物 O2/CO2燃烧 O2浓度

Formation and Properties of Submicron Particles Generated During Pyrite Combustion

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Abstract: Pure pyrite was combusted in a laboratory drop tube furnace (DTF) in O2/N2 and O2/CO2, a Dekati low pressure impactor (DLPI) was used to collect submicron particles (PM1) from pyrite combustion and obtain their mass fraction size distributions. Particle samples collected were subjected to physical and chemical analysis using an X-ray fluorescence (XRF) analyzer and a scanning electron microscope equipped with energy dispersive X-ray spectrometer (SEM-EDS). The mass size distribution, concentration, elemental composition and morphology of the PM1 were investigated. The results show that pyrite combustion has an important contribution to the PM1 formation. Under the same O2 concentration, the PM1 production and its peak size for the O2/CO2 condition are smaller than those for the O2/N2 condition. In the O2/N2 or O2/CO2 condition, the PM1 production and its peak size increase with the O2 concentration. The PM1 consists mainly of sulfur (S). The O2 concentration has an important influence on the partitioning of different S-containing compounds under the O2/N2 condition. With a low O2 concentration, the S in the PM1 mainly exists in the form of the element sulfur, with a higher O2 concentration, the S mainly exists in the form of sulfuric acid and sulfate.

Keywords: pyrite submicron particle O2/CO2 combustion O2 concentration

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