4 - 5 Estimation of Grain Size in Randomly Packed Granular Material Using Laser-Induced Breakdown Spectroscopy*

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Grain size is one of the most important physical parameters for randomly packed granular (RPG) materials. Its estimation, especially in situ, plays a key role in many natural and industrial processes. Here, the application of laser-induced breakdown spectroscopy (LIBS) was investigated experimentally to estimate the grain size in RPG materials. The experiment was performed by taking sieved copper microspheres with discrete median diameters ranging from 53 to 357 μm as examples and by measuring the plasma emissions induced by 1 064 nm laser pulses with a duration of 7 ns in an air environment (see Fig. 1). It was found that the plasma emission measurements were successful in estimating the grain median diameter via monitoring the variations in plasma temperature (electron density) at the range of median diameter below (above) a critical value. In addition, it was demonstrated that, when plasma temperature serves as an indicator of grain size, the intensity ratio between two spectral lines from different upper energy levels of the same emitting species can be used as an alternative indicator with higher sensitivity. The results show the potential of using LIBS for in situ estimation of grain size in RPG materials for the first time[1].

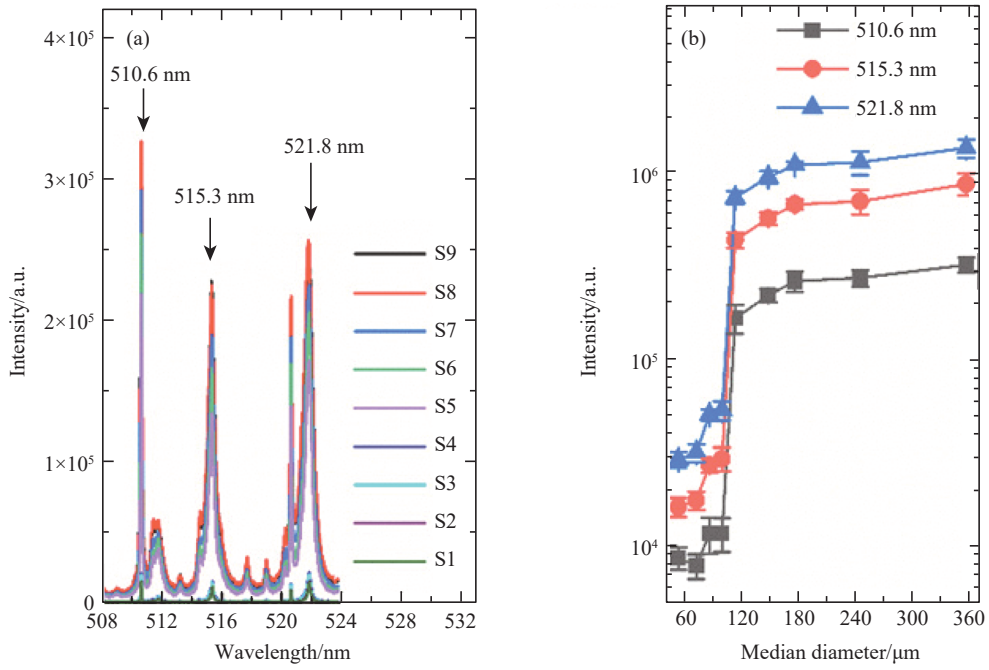

Fig. 1 (color online) (a) Spectra recorded in the wavelength range of 508∼524 nm for the nine RPG samples, (b) Intensities of Cu I lines at 510.6, 515.3, and 521.8 nm as a function of the grain median diameter. Error bars represent the standard deviation of 6 independent measurements.

Reference

[1] Y. J. Li, Chemosensors, 10(2022)144.

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