

論文内容要旨

報告番号	甲 先 第 376 号	氏 名	Renwei Liu
学位論文題目	Characteristics comparison of SP-LIBS and long-short DP-LIBS for steel measurement (鉄鋼分析におけるSP-LIBSと長短DP-LIBSの特性比較)		
<p>内容要旨</p> <p>Laser induced breakdown spectroscopy (LIBS) has high potential for on-line measurement and is of great significance to the steel industry. On-line steel measurement faces some challenges. During the manufacturing process, the sample temperature will change. There are many lines of iron. These all affect the measurement accuracy and plasma analysis.</p> <p>In this study, we established an experimental system to evaluate how sample temperature affects LIBS measurement of solid steel. The spectra at different sample temperatures are compared, and the influence of Boltzmann spectra on plasma temperature and the density of Fe atoms in plasma is analyzed. The influence of sample temperature on accuracy was quantitatively analyzed.</p> <p>The long-short DP-LIBS method was proposed and applied to the measurement of solid steel at different sample temperatures. The aim is to eliminate the influence of sample temperature on plasma. In this way, quantitative measurement results can be obtained.</p> <p>When the sample temperature increases from room temperature, the plasma temperature does not increase obviously, but the total Fe atom number and Fe⁺ ion number increase. The plasma temperature calculated by Fe atoms is lower than that calculated by Fe⁺ ions, and the number of Fe atoms is much larger than that of Fe⁺ ions. This is consistent with the thermal theory and also shows the inhomogeneity inside the plasma. When the sample temperature changes, the variation of each Fe line is also uneven, which can be observed by Boltzmann diagram.</p> <p>For the quantitative analysis of Mn, the Mn atom line is more robust than the Mn ion line. Mn atomic wires have less interference with Fe atomic wires and are sensitive to components at the evaluated sample temperature. The second-order multivariate PLS based on Mn atomic lines has higher accuracy, which shows that plasma is a nonlinear system. Adding more information and less interference to the quantitative model is helpful to improve the accuracy.</p> <p>DP-LIBS method has obvious advantages in the determination of iron. The signal is stable and the fluctuation is small. The sample temperature has less interference to the steel measurement because the surface condition is more stable. The quantitative measurement accuracy of long and short DP-LIBS is higher than that of SP-LIBS.</p>			