The effect of plume removal on welding efficiency and behavior in welding copper using 1.5kW blue diode laser

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Pure copper is used for various products due to its high electric and heat conductivity. In recent years, electric vehicles have been attracting attention to realize a carbon-neutral society, and it use many pure coppers. Therefore, it is important to achieve high quality and efficient laser welding of pure copper for realization of a carbon-neutral society. Nowadays in pure copper welding, blue diode laser has been extensively studied to achieve higher welding efficiency. This is because blue diode laser has 6 times higher light absorption of copper than near-infrared laser which have been widely used in laser welding. Therefore, we have developed the blue diode laser with a maximum output of 1.5 kW and investigate the phenomena when a pure copper is irradiated by blue diode laser. In a previous study, it was shown that when blue diode laser is used to irradiate a pure copper plate perpendicularly, blue diode laser-induced plume is generated form weld copper surface. There is concern that interference between plumes and laser beam may reduce processing efficiency and cause welding defects. One method of preventing this interference is to cut the plume with an air knife. In this study, experiments were conducted to quantify the change in welding efficiency when the plume is air-cut and to quantify the change in plume behavior using spectral analysis. Figure 1 shows the experimental set up for bead-on plate welding for pure copper plate. Welding was performed using blue diode laser with a wavelength of 450 nm, power of 1.5 kW and speed of 25 mm/s. A high-speed camera was employed to monitor the welding performance. In addition, spectral analysis was performed with a detection field of view of φ100 μm. The plume was detected at a height of 0.2 mm directly above the copper plate and the results of the spectral analysis are shown in Figure 2. It was found that the intensity of Cu was higher than that of CuO directly at a height of 0.2 mm.

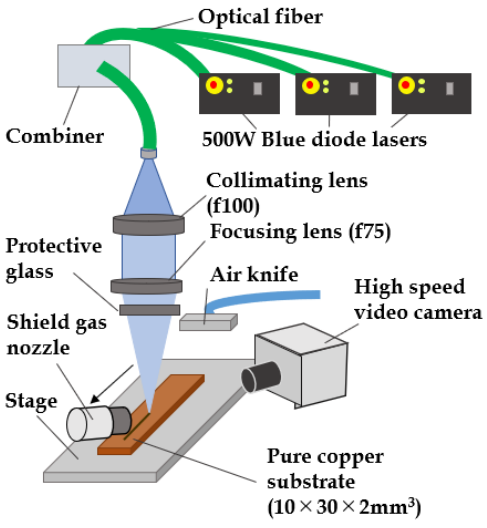

Figure 1 The experimental set up for spectral analysis of pure copper welding

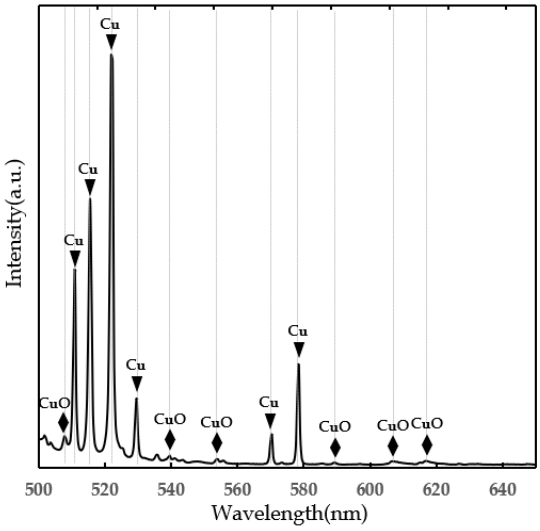

Figure 2 The results of spectral analysis of blue diode laser-induced plumes during pure copper welding at output power 1400 W