IECME 2025 Conference

The 2nd International Electronic Conference on Metals

05–07 May 2025 | Online

MDPI

Laser marking of stainless steel and aluminum

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INTRODUCTION & AIM

The marking of components using laser technology is a permanent process that utilizes a beam to create a mark, or even engrave, on the surface of a component. Due to the potential marking quality, this process is increasingly employed across various industries (semiconductors, electronics, medical, automotive, aerospace, etc.) for engraving serial numbers, logos, barcodes, QR codes, and more. Several laser processing parameters influence the marking quality as well as penetration. Depending on the component and material involved, these parameters must be adjusted to determine the optimal settings for each component/material. This work investigates the influence of laser processing parameters on the marking quality of stainless steel and aluminum.

METHOD

A 30 W fiber laser with a wavelength of 1064 nm was employed in the following parametric study focused on power, frequency and marking speed (Table 1). The materials studied were aluminum alloy AW-6082-T6 and stainless steel 304 2B, both processed with a single scan.

Table 1: Materials and laser processing parameters

Materials	Power (%)	Frequency [kHz]	Speed [mm/s]
Aluminum AW-6082-T6	10 to 100 in increments of 10	10 to 80 in increments of 10	1000 and 2000
Stainless steel 304 2B			

Two power-frequency matrices were explored for each material by varying the scanning speed, as indicated in Table 1. Figure 1 presents an illustration of the matrix template.

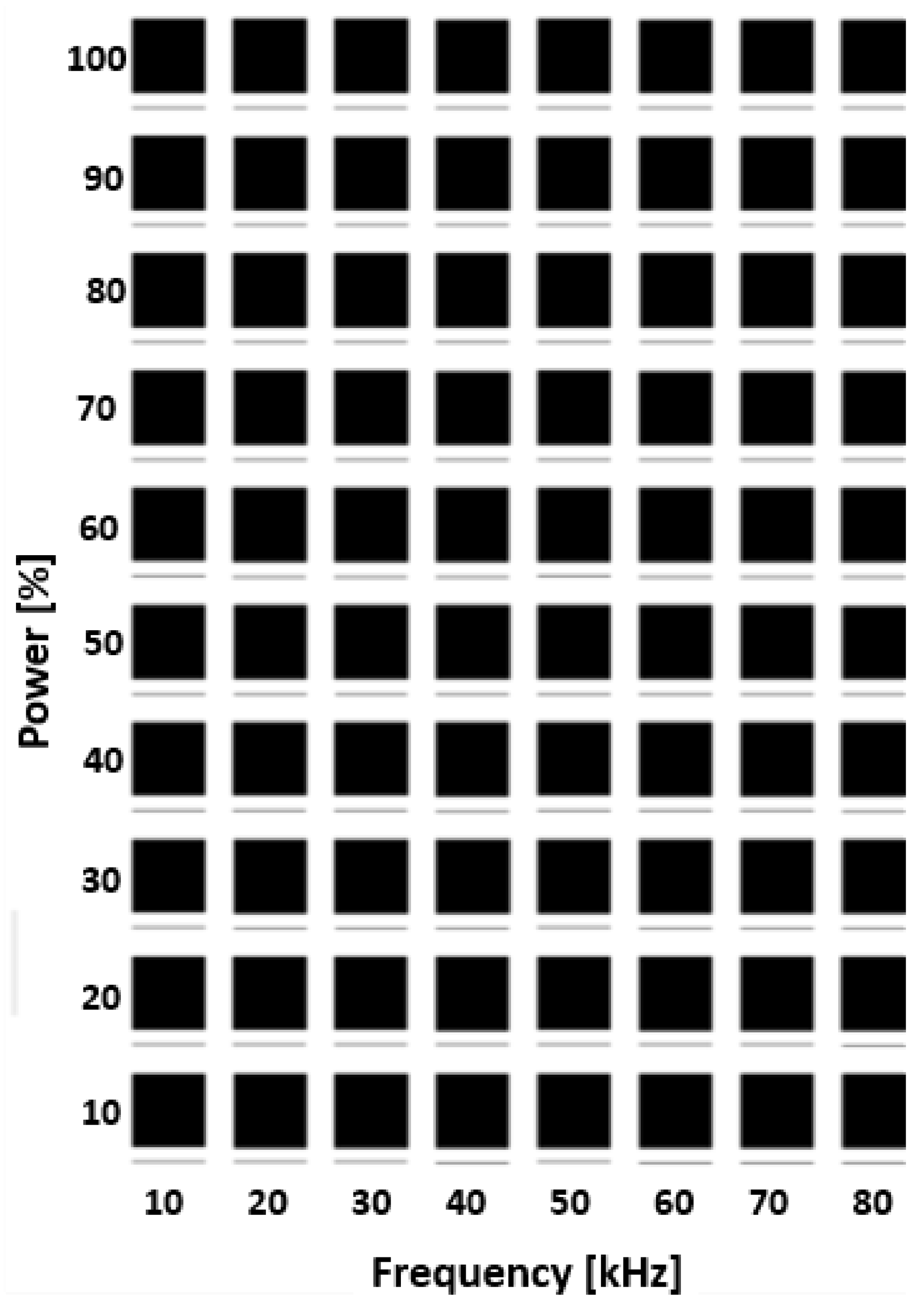

Figure 1: Power-Frequency matrix template

RESULTS & DISCUSSION

Figures 2 and 3 present the power-frequency marked matrices for AW-6082-T6 aluminium alloy and 304 2B stainless steel, respectively. The results demonstrate that the markings varied in color and quality, and it was possible to identify the optimal parameter sets for each material to ensure the best marking quality, even at high marking speeds, as highlighted in Figures 2 and 3.

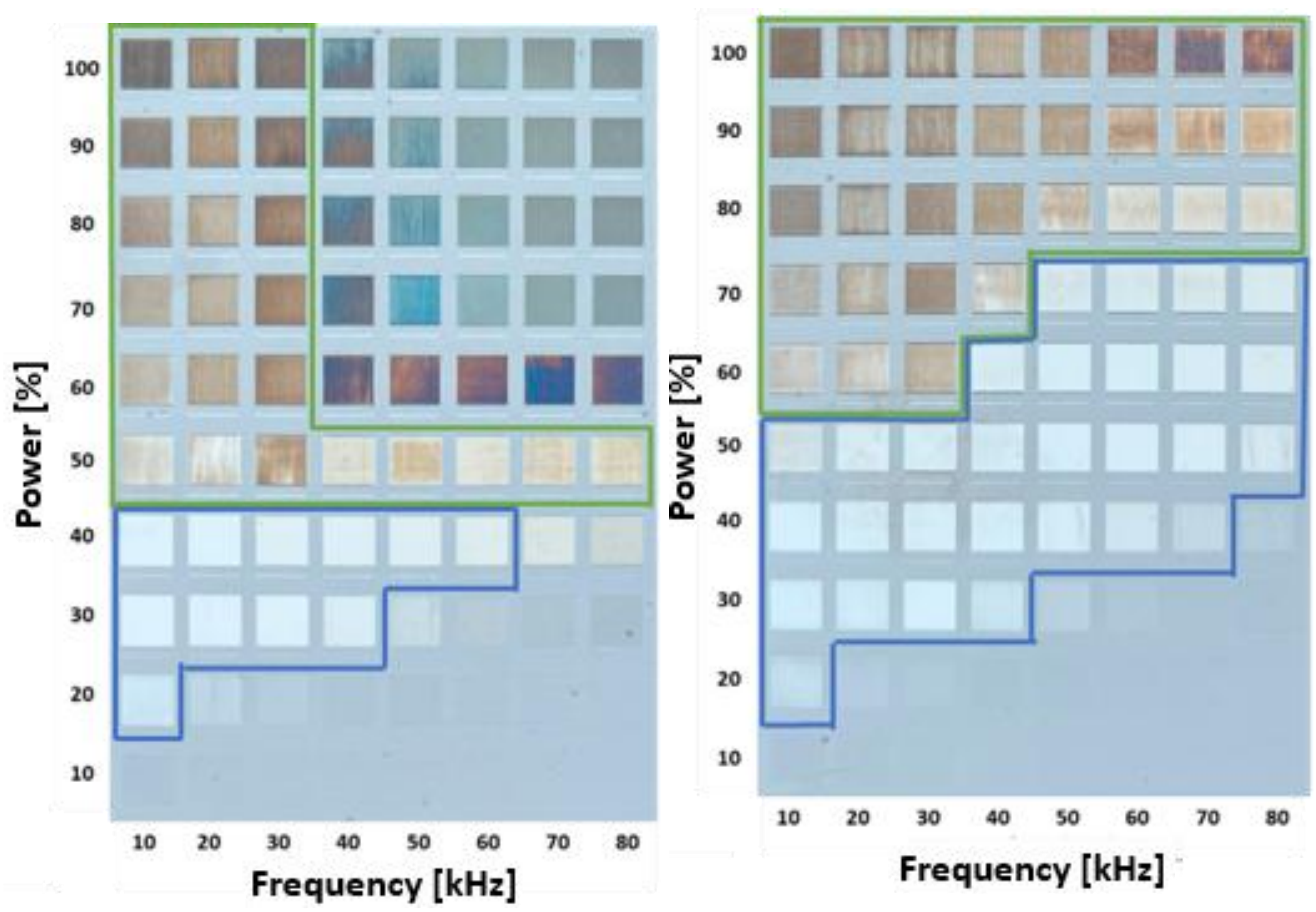

Figure 2: Stainless steel 304 2B marked at 1 m/s (left) and 2 m/s (right).

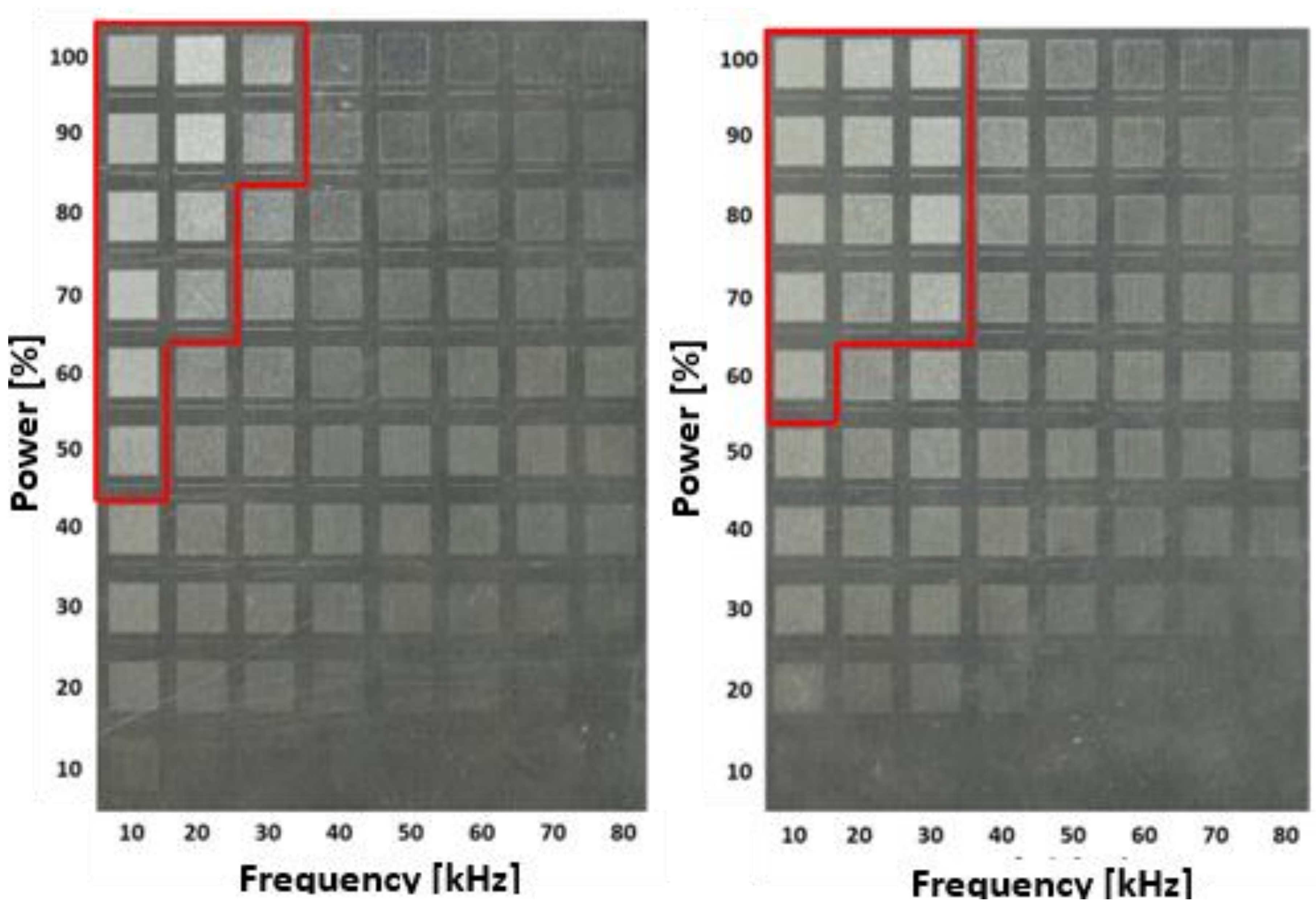

Figure 3: Aluminum AW-6082-T6 marked at 1 m/s (left) and 2 m/s (right).

CONCLUSION

- The marking strategy influences the marking quality, making it possible to obtain dark and light markings.
- For instance, for Aluminum AW-6082-T6, good quality light markings were obtained at 1 m/s, with 100 W and 10 kHz.
- It is possible to create and control marking colors for stainless steel.