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## Erasing and rewriting of titanium oxide colour marks using laser-induced reduction/oxidation

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### Abstract

Laser-induced oxidation of metallic surfaces such as titanium is used in many application areas for colour marking due to its selectivity, cleanness and processing speed. However, as the generated colours are permanent this reduces the flexibility and applicability of this laser processing technology. Therefore, a method is reported in this paper to erase selectively the oxide-based colours using laser-induced oxygen reduction. Especially, the colour marks are reprocessed in a low oxygen environment employing a nanosecond laser. A low fluence was used in order to diffuse oxygen out into the atmosphere and yield a lower form of metal oxides or a pure metal. Any cumulative fluence exceeding  $25 \text{ J/cm}^2$  was sufficient to erase any laser-induced colours on titanium substrates. The XPS analysis revealed that all fields were mainly comprised of  $\text{TiO}_2$  prior to erasing with only small contributions from  $\text{Ti}_2\text{O}_3$  and  $\text{TiO/TiN}$ . Following the proposed laser-induced oxygen reduction, the relative concentration of  $\text{TiO}_2$  decreased substantially while the overall amount of Ti in the near surface region increased. The results clearly show that the erasing of oxide-based colour marks is only due to oxygen diffusion back into the atmosphere and there were not any signs of laser ablation.

**Keywords:** nanosecond laser, Laser-induced reduction, metallization, titanium oxide, color erasing, color rewriting, color marking,

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