

# Laser cleaning of steel structure surface for paint removal and repaint adhesion

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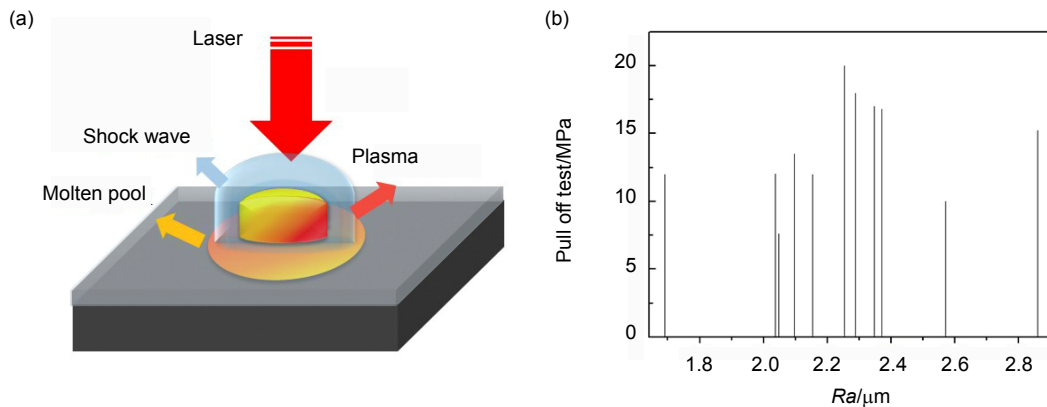
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(a) Laser removal of paint. (b) Adhesion under different roughness.

**Abstract:** Laser ablation has been widely applied to clean metal surface artefacts, microelectronics and nuclear decontamination. In shipyards, paint removal is conventionally done with sand blasting, which is an environmentally unfriendly as fine grit particles used during sand blasting are difficult to be cleaned away. Meanwhile, unhealthy problems of sand blasting affect workers' health. Laser ablation is proposed as a substituting method. In this work, laser removal of paint on steel is executed for shipyards of marine and offshore engineering. Nd:YAG pulse laser with wavelength 1064 nm can efficiently remove the paint and does not damage the substrate after scanning triple times. With the 100 ns pulse width, the temperature rises in a very short time and results in partial material vaporized quickly from the surface. A suction pump is set beside the substrate to absorb the ablated debris. By comparing with the ISO 8501 standards, preparation of steel substrates before the applications of paints and related products, the cleaned surface achieves ISO 8501 standard SA2. The liner roughness  $Ra$  and three dimensional roughness  $Sa$  of the laser cleaned surface are measured to be in a range from 1.691  $\mu\text{m}$  to 2.859  $\mu\text{m}$  and 0.019 mm to 0.043 mm, respectively. The painting is carried out with Jotamastic 87 aluminium paint, which can be used in marine for outside surfaces of hulls. The repaint is cured in room temperature and pressure for one day before leaving it in an oven for three days at 105  $^{\circ}\text{C}$ . The adhesion test is performed according to ISO 4624 pull-off test. The evaluation of the tests is based on the percentage of dolly removed paint area. With the textured morphologies of tiny pores, holes and voids created by laser ablation, the paint spreads and solidifies into these microstructures and forms the mechanical bond. The repaint is embedded onto the rough surface to bond much more tightly. The excellent adhesion strength of 20 MPa between repaint and the substrate is achieved and even the lowest adhesion of 7.6 MPa is much higher than the standard of 3 MPa set for ship hull.

**Keywords:** laser; steel structure surface; paint removal; repainting adhesion

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