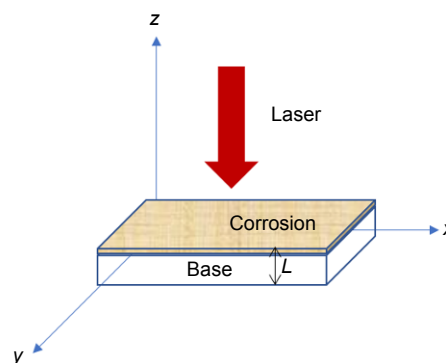


Mechanism of laser derusting and surface properties of low carbon steel

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Laser and corrosion in the cartesian coordinate system.

Abstract: Laser cleaning technology is very useful and promising in mechanical industry, micro-electronic industry, artwork restoration and other special areas, which has attracted great attention among researchers. Many experimental and theoretical studies on laser cleaning have been carried out in the past years. Low steel has wide application. But for some low steels in an environment prone to rust, traditional rust removing methods can be replaced by laser derusting technology, which has a broad prospect. The corrosion surface of the laser radiation has the characteristics of high laser energy and short pulse, so that the corrosion temperature quickly reaches above the melting point. So laser derusting is mainly through the ablation mechanism to achieve cleaning effect. The corrosion of low carbon steel is mainly composed of the mixture of Fe oxide and its hydrate, and the surface oxygen content can be used to effectively characterize the effect of rust removal. The laser spot area is much smaller than the cleaning corrosion area and the laser pulse has short pulse width, so that the range of laser heat conduction is very small in the plane direction. It can be considered that the plane direction has uniform heat, so the Fourier heat conduction model is used to characterize the corrosion of surface heat conduction. In fact, when a laser beam irradiates the rust layer surface, it can not only remove the rust layer but also influence the performance of the cleaned surface. At the same time of laser rust removal, there will be some laser directly through the rust layer, and the laser radiation on the corrosion surface will also transfer part of the energy to the metal substrate surface through heat conduction. By means of experimental analysis on the surface of the metal base, microstructure, mechanical properties and hardness were studied and compared that indicate laser derusting technology does not damage to the metal substrates and the properties of the surface has not been affected. Laser derusting has little effect on metal, so the mechanical properties of metal substrate are characterized by using technology instrumented indentation technique. The technique needs to measure the load and displacement data during the whole indentation process and plot the load-displacement curve (P-h curve). And then, mechanical properties, such as elastic modulus, yield strength, ultimate tensile strength, strain hardening exponent and extension ratio, can be calculated from the P-h curve with the specific algorithm.

Keywords: laser cleaning; mechanism; rust removal; low carbon steel; surface properties

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