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# The influence of femtosecond laser repetition rates and pulse numbers on the formation of micro/nano structures on stainless steel

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Abstract:

Micro/nano structures on stainless steel were prepared by femtosecond laser pulses (800 nm, 35 fs) with different repetition rates and pulse numbers in air. Environmental scanning electron microscopy and energy dispersive spectroscopy (ESEM/EDS) were used to study the detailed morphology, microstructure and composition. Femtosecond laser ablation areas were measured and compared. Ablation thresholds were calculated. Results showed that the laser-induced microstructure consists of two distinct regions: a core region of moth-eye-like structure and a peripheral region of micro/nano periodic structures surrounding the core. Nano particles were observed on those micro/nano structures. The dimension of moth-eye-like structure increased dramatically with increasing pulse numbers due to the incubation effect; and the amorphization of micro/nano structures became more serious with the increasing repetition rates. EDS results indicated that the atomic ratio of Cr increased slightly after laser irradiation. The laser induced damage threshold (LIDT) decreased with increasing pulse numbers. The reflectivity of stainless steel decreased for 25 times after laser irradiation. The formation of micro/nano structures can be explained by the plasma resonance absorption model.

*Keywords: Micro/nano structure, Femtosecond laser, Anti-reflection, Stainless steel, ESEM*

## 1 Introduction

Metals with micro/nano structures often have unique properties such as self-cleaning, anti-microbial, anti-reflection and broad spectrum absorption, and can be potentially applied in food industry, aerospace, clean energy and biomedical fields [1-6]. Recently, micro/nano structuring technologies have been studied actively and interesting results have been obtained. However, most of the traditional techniques, e.g. acid etching or mechanical processing are low efficiency, environmental unfriendly or lack of precision. Thus, the development of a new technique for the preparation of micro/nano structure is urgently

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