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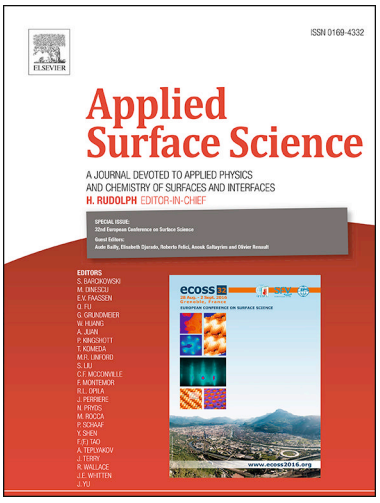

Full Length Article

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Combined Surface Hardening and Laser Patterning Approach for Functionalising Stainless Steel Surfaces

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Abstract

The paper reports a laser patterning method for producing surfaces with dual scale topographies on ferritic stainless steel plates that are hardened by low temperature plasma surface alloying. Nitrogen and carbon based gasses were used in the alloying process to obtain surface layers with an increased hardness from 172 HV to 1001 HV and 305 HV, respectively. Then, a nanosecond infrared laser was used to pattern the plasma treated surfaces and thus to obtain super-hydrophobicity, by creating cell- or channel-like surface structures. The combined surface hardening and laser patterning approach allowed super-hydrophobic surfaces to be produced on both nitrided and carburised stainless steel plates with effective contact angles higher than 150^0. The hardened layers on nitrided samples had cracks and was delaminated after the laser patterning while on plasma carburised samples remained intact. The results showed that by applying the proposed combined approach it is possible to retain the higher hardness of the nitrided stainless steel plates and at the same time to functionalise them to obtain super-hydrophobic properties.

Keywords: Laser patterning; nanosecond laser; hydrophobicity; plasma surface alloying; hardening; surface engineering.

1. Introduction

Surface functionalisation technologies have many industrial applications due to the added value that they offer to existing and new emerging products. Especially, these technologies allow the surface properties of products to be modified, i.e. to enhance or incorporate new properties such as hydrophobicity [1], bacteria repellence [2], self-cleaning [3], heat transfer improvements [4], wear resistance [5] and/or anti-icing [6]. In markets with many competing products, customers are more likely to choose those that offer a better performance and integrate more functions while are still produced cost-effectively and hence are competitively priced. Therefore, the technologies for surface functionalisation are of great importance in many industrial sectors, e.g. in life sciences, transport, energy and other application areas. The two main approaches to obtain such