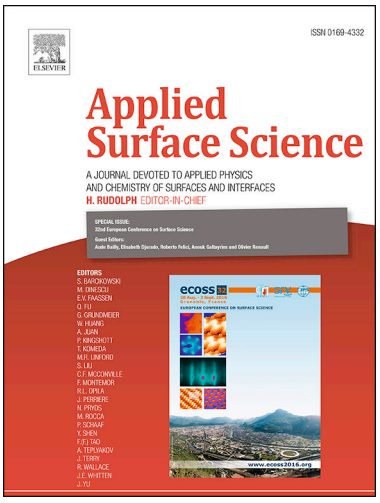

Full Length Article

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Single-Step Selective Metallization on Insulating Substrates by Laser-Induced Molten Transfer

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Abstract: A novel approach named laser induced molten transfer (LIMT) was proposed to rapidly fabricate the metallic patterns on the insulating substrates with high bonding strength by nanosecond laser direct writing. The laser beam selectively irradiated and melted the donor foil and transferred the molten droplets on the target substrate by the induced laser shock, resulting in the formation of designed metallic pattern. The processing parameters were firstly optimized, the morphology of transferred pattern was characterized, and the pattern conductivity and bonding strength were investigated experimentally. The optimized processing parameters for the fabrication of high-quality pattern were the scanning speed of 750 mm/s, laser power of 21 W, and scanning interval of 15 μm. This transferred copper pattern was porous and composed of aggregated micro droplets. The copper pattern surface was homogeneously rough and its edges were clear. The electrical resistivity of transferred pattern was approximately 8 times of the bulk copper due to the oxidation of copper droplets and porosity of pattern. The transferred copper pattern has good bonding strength on the glass substrate due to the existence of a copper-glass recast layer. A micro-heater pattern was integrated in a microfluidic chip, which demonstrated the LIMT approach can selectively transfer pattern on 3D surface. LIMF can successfully transfer the pure metal and alloy patterns on the various target substrates, even the flexible substrate, which further exhibited its excellent versatility and flexibility.

Keywords: metallization; pattern; laser-direct writing; glass; polyimide; bonding strength

1. Introduction

In recent decades, the fabrications of metallic patterns on insulating substrates have received increasing attention due to their wide applications, including displays [1, 2], sensors [3, 4], batteries [5, 6], microelectronics [7, 8], microfluidics [9, 10], and so on. Commonly, photolithography combined with vacuum deposition is suitable for the metallic pattern on insulating substrate with a good alignment [8]. However, the demand of costly equipment and the complex process prohibit its further application