3D Glass Decoration by Nonlinear Absorption of Ultrafast Lasers

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Abstract

In the frame of decorative applications, several techniques exist nowadays to color various kinds of glassware. Nevertheless, most of these processes employ toxic chemical additives and are characterized by long processing time. It is well known that precipitation of metallic nanoparticles in glass by laser processing allows for 3D intra-volume glass coloring with high-resolution patterning into bulk glass. In this work an ultrafast laser with a central wavelength 1030 nm was employed to irradiate FOTURAN ® photosensitive glass doped with Ag nanoparticles, and the color variation is obtained by simply varying the laser and process parameters. The laser-irradiated samples were annealed in oven at different temperatures around the glass-transition temperature to assess the effect of annealing on the final colorization. All treated samples were characterized by measuring the absorption coefficient in the visible spectrum by a SHIMADZU spectrometer UV3600PLUS. Results show that the absorption coefficient increases when the cumulative energy employed during the process increases. The post-irradiation annealing process enhances the coloring effect. Finally, thicker samples of FOTURAN ® II, which is an improved photo-sensitive glass based on the well-known FOTURAN ®, were treated with the best parameters studied in the first part with a 3D pattern to evaluate the process resolution.

Keywords: Glass decoration, ultrafast laser, nonlinear absorption

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