Thermo-mechanical model of CO_2 laser-induced damages on decorative glass

Alex Capelle[1-2], Barthélemy Aspe[1], Babacar Diallo[3], Olga Shavdina[2], Nadia Pellerin[3], Martin Depardieu[2], Anne-Lise Thomann[1], and Nadjib Semmar[1]

[1] GREMI – CNRS UMR7344 – Université d'Orléans, 14, rue d'Issoudun 45067 Orléans, France
[2] Décor World Services (DWS), 1, Av. du Champ de Mars 45000 Orléans, France
[3] CEMHTI – CNRS UPR3079, 1, Av. De la Recherche Scientifique 45100 Orléans, France
*Corresponding author email: nadjib.semmar@univ-orleans.fr

In this study, we analyzed texturing features created by a Carbon Dioxide (CO_2) laser on decorative soda-lime glass (SLG). The focused laser beam is moved on the glass surface with controlled process parameters *i.e.,* laser output power (P) and beam sweeping speed (V). This process creates typical grooves and cracks at the glass surface[1]. Three features are analyzed in this study *i.e.*, (i) the width of the damaged region, (ii) the depth of the damaged region, and (iii) the number of glass fragment per unit area. Those three features are compared with the process parameters to build a thermo-mechanical model[2]. The goal here is to explore both analytical- and Finite-Element-Method (FEM)-based models to predict decoration features on glass.

A large range of parameter values is explored (P = [6.2, 20.3] W and V = [50, 3000] mm/s). The glass surface modifications are observed under a microscope and the images are numerically processed to extract the features (i), (ii), and (iii). Typical image from the microscope and corresponding image-processed result is presented in **Figure 1.**

To gain insight on the mechanisms involved during the laser texturing process, we developed a thermo-mechanical model based on an FEM-approach using COMSOL Multiphysics®. This numerical model allowed us to estimate the sensitivity of the model on different parameters such as glass material properties.

Finally, we derived analytical equations from the literature to develop a simple analytical model, the accuracy of which will be compared to both experimental and numerical results.

Figure 1 : Image processing result for decoration features extraction. White area is the Region of Interest (ROI) and colored lines are segmented glass fragment contours.

References:
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