Influence of gas discharge treatments on glass-ceramic surfaces

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Abstract

The aim of our investigation is to functionalise the surface of a glass-ceramic precisely to improve its properties, like mechanical strength and hardness, for different applications, e.g. as cooktops. So far, different methods to tailor surface properties involved an additional process step and either high temperatures or additional chemicals. To functionalise glass-ceramics intrinsically during the ceramisation, a setup was built where an electric field is applied across a glass sample inside a furnace. The used furnace was built for this research project to achieve a very high temperature homogeneity (± 3 K) within its chamber (cross-sectional area 40 cm x 40 cm) so that larger glass-ceramic samples can be produced without deformation and inhomogeneous crystallisation, eventually. With the chosen open electrode setup, consisting of a bottom plate electrode and a top wire electrode parallel to the sample surface, the influence of electric fields and furnace atmospheres at elevated temperatures can be analysed simultaneously. This specific electrode setup leads to a strong inhomogeneous electric field which results in a glowing gas discharge at voltages of up to 6 kV. The treated glass samples are ceramised subsequently in the same furnace. The analysis of these so called thermally poled glass-ceramics by GI-XRD shows a differing crystallinity profile in a thin surface layer with different applied poling currents (and therefore different electric field strengths), furnace atmospheres and treatment times. Furthermore, the treated surface area appears different after ceramisation, when examined optically.

Keywords: glass, ceramic, surface, thermal poling, gas discharge

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