SELECTIVE LASER HEAT TREATMENTS FOR MELTING AND CRYSTALLIZATION OF GLASS

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Purpose
The piezoelectric glass ceramic investigated in this study contains fresnoite crystals in a glass matrix and is obtained by crystallization of a parent glass of the SrO-SiO₂-Al₂O₃-K₂O-TiO₂ system. The laser treatment is realized in 2 steps:
1) Creation of an amorphous homogeneous coating from a parent glass crushed in powder
2) Crystallization of this amorphous coating.

Lasers characteristics

<table>
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<tr>
<th>Laser CF10:</th>
<th>Laser Trumark Station 5000 (Trumpf):</th>
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<tbody>
<tr>
<td>- Solid-state laser</td>
<td>- Solid-state laser</td>
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<tr>
<td>- Yb-doped</td>
<td>- Nd:YVO₄</td>
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<tr>
<td>- Pmax=8,6 W (cw)</td>
<td>- Pmax=22,8 W (cw)</td>
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<tr>
<td>- λ=1071 nm</td>
<td>- λ=1064 nm</td>
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<tr>
<td>- Beam TEM₀₀ (Gaussian)</td>
<td>- Beam: TEM₀₀ (Gaussian)</td>
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Devitrification of a glass coating formed by scan laser on compact

1. Scan laser
From samples with laser conditions as figure C, we realized a third laser scan to devitrify these one. The applied energy for the third laser scan had to be increased (vectorization from 40 to 10 μm). It seems that crystallization didn’t appear with minder applied energy because of a lack of time to permit the kinetic of crystallization. Crystallization must be appearing in the sawing of the scan laser when the thermally affected zone cooled.

Figure E: Formation of dendrites can be seen.

Figure F: The dendrite structure is about 100 μm (white coating). Under this dendrite structure, a coating of melt glass had a thickness between 250 and 600 μm.

XRD patterns
XRD pattern reveals a partial crystallization of SrTiO₃ (Fig. G) and not Sr₂TiSi₂O₈.

2. Furnace treatment
Glass coating with laser parameters as figure C were realized.
Crystallization of the glass square was performed by a furnace treatment (5°C/min to 800°C; holding 800°C 1h). XRD pattern reveals partial crystallization of Sr₂TiSi₂O₈ (Fig. H).

Conclusion
The first results show that suitable scanning conditions make possible to obtain a dense and homogeneous glass powder coating. Devitrification of the glass powder coating may be realized with the laser. Moreover, the XRD patterns and the SEM observations highlight that the coating is only partially crystallized.

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