Enhancement of the preferentially orientated microstructure of polar STS glass ceramics

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The present work focuses on polar glass-ceramics based on STS crystals ($Sr_2TiSi_2O_8$) that have demonstrated their potential for the design of surface acoustic wave (SAW) devices, functional up to temperatures around 1000°C [1-2]. A specificity of these polar glasses-ceramics is the requirement of strongly preferentially orientated microstructure, induced by a surface crystallization mechanism, to promote the macroscopic piezoelectric effect.

Previous works have shown a strong issue in the mastering of the orientation of the STS crystal plans over the depth. However, for the SAW generation, an accurate control of the piezoelectric properties over a depth corresponding to one wavelength is compulsory (i.e. up to 1 mm for low frequencies) [3].

In the present work we study the effect of the surface state of the parent glass, the environment, and the parameters of the crystallization heat treatment on the microstructure of the glass-ceramics.

It is demonstrated that the growth rate of the crystallized layer on mirror polished parent glasses, leads to a strong preferential orientation of the STS crystal polar axis over a depth that exceeds 1 mm.

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[3] D. Royer and E. Dieulesaint, Elastic Waves in Solids (Springer, Paris, 1999), Vol. II, 446 pp.