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Title:

Influence of a thermal gradient and/or an electrical field on the crystallization of a piezoelectric phase in a glass-ceramic.

Authors & affiliations:

M-S. Renoirt, M. Gonon
Material Institute – University of Mons

Abstract: (Your abstract must use **Normal style** and must fit in this box. Your abstract should be no longer than 300 words. The box will 'expand' over 2 pages as you add text/diagrams into it.)

Piezoelectric ceramics are used in numerous components (sensors, actuators), presents in everybody's life. Most of these piezoelectric ceramics are polycrystalline and ferroelectric. These ceramics need to be poled under a high strength electric field before use. The main drawback of these compounds is that a depolarization takes place with time or increasing temperature. Although exhibiting much lower electromechanical performances, non-ferroelectric piezoelectric phases (e.g. quartz) are not affected by this drawback. However, in that case, macroscopic polar properties must be conferred during processing. This can be the case using the glass-ceramic technology if a preferential crystal orientation is promoted during the crystallisation step.

A PhD thesis performed at UMONS (N. Maury, 2013) has shown that preferential orientation of piezoelectric fresnoïte crystals can be obtained by isothermal heat treatment on appropriated glass composition. Such materials exhibit surface nucleation and crystallization mechanisms with (00l) lattice plans preferentially orientated parallel to surface. Crystallization further propagates into bulk with time (fig. 1).

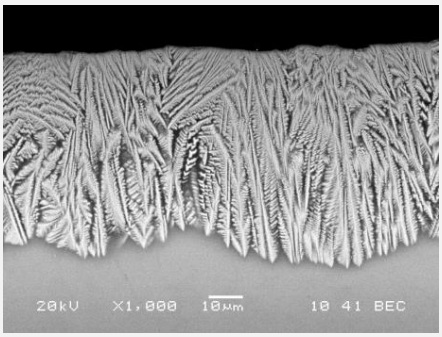

Figure 1 : Surface crystallisation in a fresnoïte glass-ceramic

Piezoelectric performances of these glass ceramics remains modest. Two reasons may explain this: i) A loss of preferential orientation in the material bulk; ii)- 180° dipolar moment inversions between crystals.

In the present work, in order to valid these hypotheses and to improve the glass-ceramic performances, a thermal gradient and an electrical field are applied during the crystallization. In the first case, the aim is to favour crystals growth from the warmest side. In the second case, the aim is to force dipolar moments alignment.

On that purpose, a homemade furnace has been built (fig. 2). Microstructures and piezoelectric performances of glass-ceramics crystallized in this specific furnace with or without thermal gradient and/or electric field were investigated and compared to results obtained in a conventional furnace.

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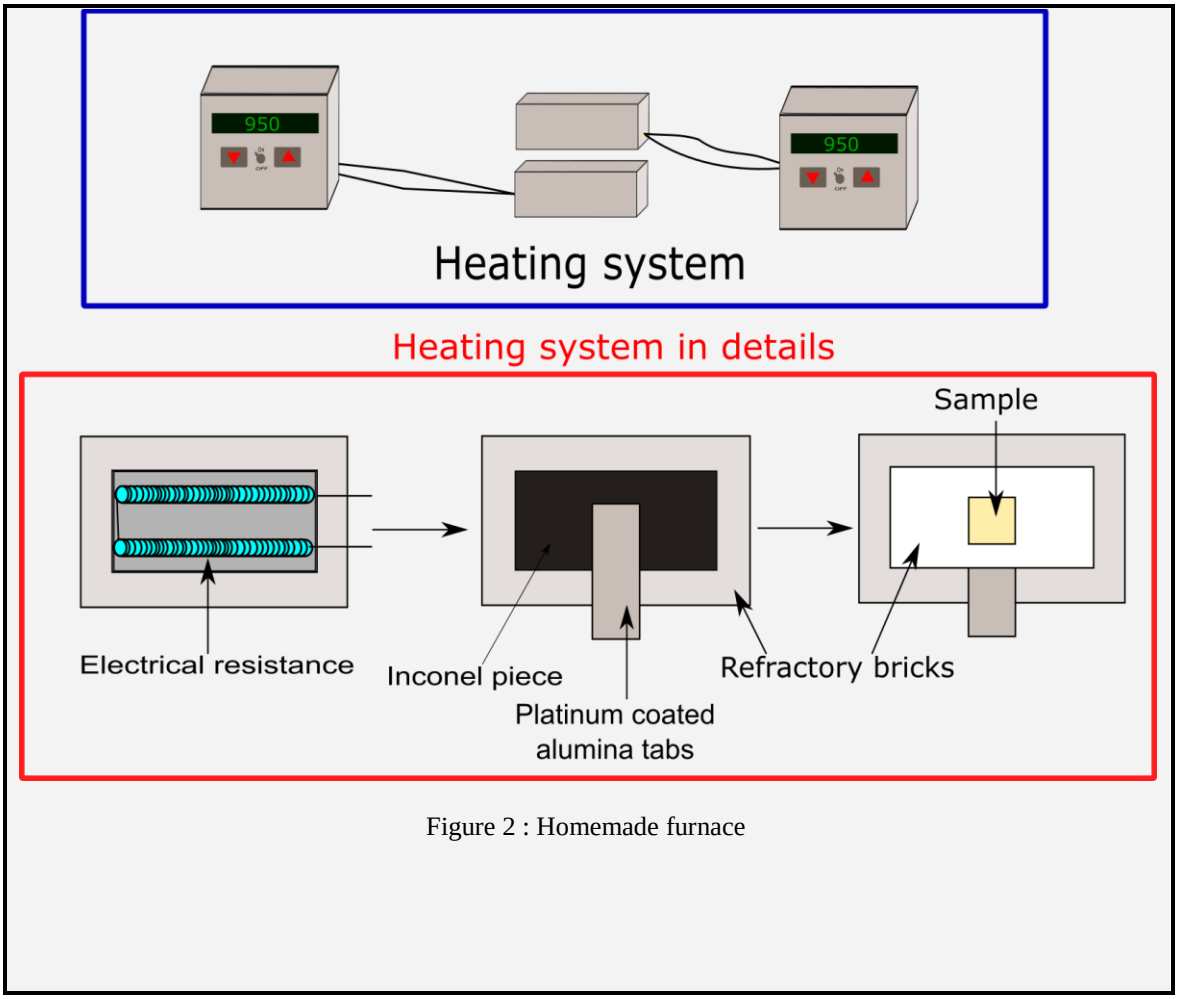

Figure 2 : Homemade furnace