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► To cite this version:

Luiz de Paula Pereira, Rafaël Bianchini Nuernberg, Olivier Podda, Norma-Maria Pereira Machado, Annabelle Laplace-Ploquin, et al.. A Feedback mechanism between crystals and bubbles in a RuO₂-bearing melt. 26th International Commission on Glass XXVI International Congress, Jul 2022, Berlin, Germany. cea-03776074

HAL Id: cea-03776074

<https://cea.hal.science/cea-03776074>

Submitted on 13 Sep 2022

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A Feedback mechanism between crystals and bubbles in a RuO₂-bearing melt

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Crystals are known to affect bubble behavior in natural and industrial oxide glass melts.[1] In volcanology, high crystal contents ($\phi_c > 30$ vol.%) may drastically increase the suspension viscosity, altering bubble dynamics severely enough to modify the eruptive style.[2] During industrial glass production, crystals may affect the process and the final product, if formed in an uncontrolled way. In this work, we investigate in laboratory-scale how a small crystallinity of nano-sized RuO₂ ($\phi_c \sim 2$ vol.%) modifies bubble behavior in a melt, generating a cyclic gas-release phenomenon (Fig. 1).

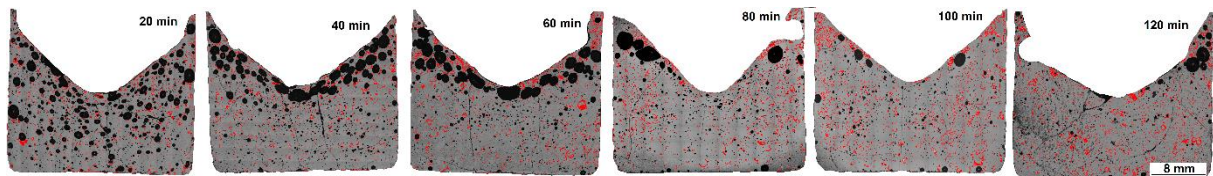


Figure 1: Optical microscope images of samples containing a borosilicate melt (grey), RuO₂ crystals (red), and bubbles (black) prepared at 1000 °C different dwell times.

We conduct a series of experiments on a three-phase system composed of a borosilicate melt, bubbles, and RuO₂ crystals. Optical microscopic investigation is performed on the products of thermal treatment at 1000 °C for different durations. Based on viscosity measurements, contact angle measurements, and numerical simulations, we propose a mechanism of entrainment of bubbles carrying crystals to the upper surface accompanied by crystal aggregation, and followed by an increase in viscosity to explain the observed phenomenon.

References

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