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Composite nanomaterials synthesys

Oxyfluoride glass ceramics using silicate glass and various fluoride crystal counterparts which are superior for various optical applications.

Composite materials such as glass ceramics are important, functional material which comprises the best properties of glass and crystalline matter. This provides a chemically stable, thermally, and mechanically durable material with superior optical properties which commonly are characteristic to much more expensive, however, fragile crystals. This material finds many applications in household and industry.

SYNTHESIS

Melting

Before beginning our research, we make a selection of appropriate chemical compositions of the base glass, with the addition of optically active ions which also acts as nucleating agents.

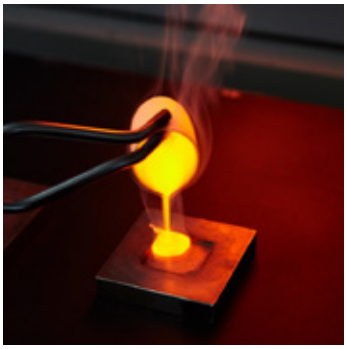
When the materials are selected, all starting ingredients are mixed in the crucible. Then the mix is melted in the oven at high temperatures ranging from 1200 – 1500 C depending on used materials. Temperatures as high as 1750 C can be reached.

Casting

The melted substance is poured onto a stainless-steel block and immediately covered with another steel cover to provide rapid quenching and thus freezing the substance in a glass state.

Raw glass material should be quenched at medium temperatures to release internal stresses under which the material could collapse.

Quenched material is now ready for further treatment and manipulations.



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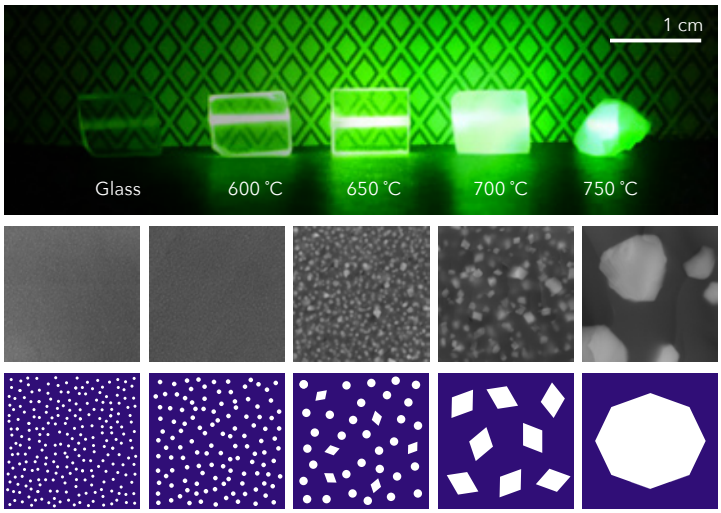
Thermal treatment

Samples of necessary size are cut to appropriate sizes and polished to fine optical quality for various analytical procedures. The size of incorporated crystallites depends on this treatment. Crystallites are formed around rare earth ions which act as crystallization centers also.

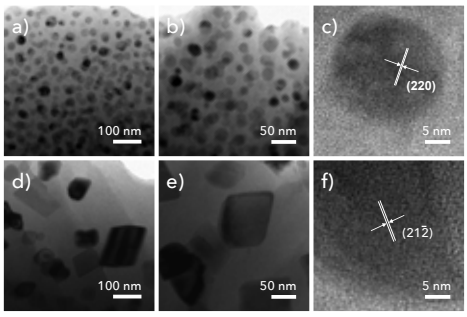


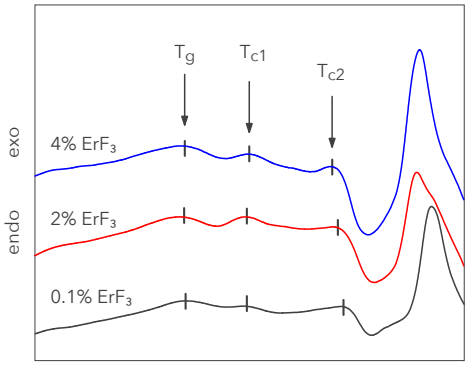
CHARACTERIZATION METHODS OF GLASS-CERAMICS MATERIALS

Main methods for characterization of glass-ceramics materials.

Electron microscopy

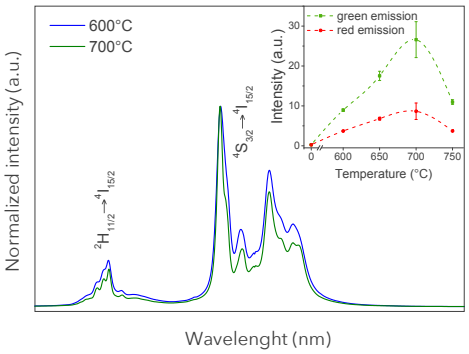
The size, shape and even crystallographic structure could be investigated.





Differential Thermal Analysis (DTA)

All oxyfluoride glass-ceramic samples undergo DTA analysis. This method reveals particular phase transitions in the sample and allows us to establish parameters of further thermal treatment to obtain a successful final product.

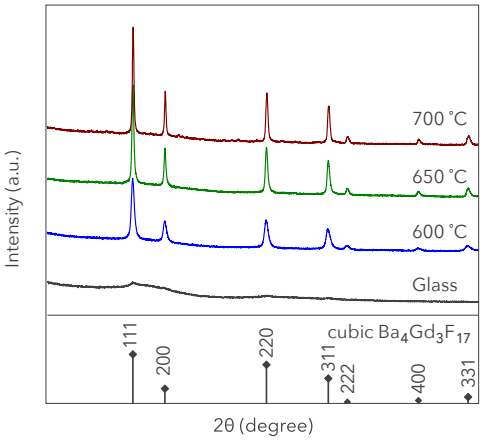


Optical spectroscopy

We use our versatile laser spectroscopy equipment to characterize optical properties of produced glass ceramics samples.

X-ray diffraction analysis

Obtained X-Ray diffraction patterns directly show thet crystallographic configuration of produced crystallites. Their size is temperature dependent.



Magnetic resonance spectroscopy

The structure of electronic centers are investigated with electron paramagnetic resonance spectroscopy (EPR). This method is a fundamental research tool in solid state physics for analyzing paramagnetic centers in solid matter.