Nucleation and anionic environment of Er^{3+} in a germanate glass

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Nanophase structures are achieved in glass-ceramic materials through efficient nucleation and slow crystal growth. The crucial problem in getting such materials is the nucleation of the starting glass and the way to initiate it.

We have investigated the nucleation of PbF_2 crystallites in a germanate glass (GeO_2-PbO-PbF_2) doped with different erbium oxide and halides: Er_2O_3, ErF_3, ErOF and $ErCl_3$. Differential Thermal Analysis, using coarse and fine powder, has been done on the same glass composition doped with a variable content of these four erbium compounds.

With ErF_3 doping, a clear homogeneous nucleation of PbF_2 is evidenced and used to make successful transparent glass-ceramics [1]. With Er_2O_3 and ErOF doping, no heterogeneous nucleation is observed and it is not possible to get a glass-ceramic from this doped glass. With $ErCl_3$, a simultaneous phase separation, without crystallisation of the oxide matrix, accompanying the crystallisation of PbF_2 gives rise to opaque samples.

A memory of the way of introduction of the rare earth ions is then kept after melting of the initial polycrystalline powders. Most probably, the initial coordination sphere of the rare earth ions is preserved through the melting process as verified with our thermal analysis and with the variable nucleation tendency observed in the different glasses. These observations confirm other observations concerning memory effects in the way of introducing doping ions in a melt [2,3].

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