OPTICAL CERAMICS Mg_2SiO_4:Cr FROM NANOSIZED POWDERS

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Nanosized glass-ceramics on the base of forsterite can be prepared by melting the batch materials SiO_2, MgO, TiO_2 in an air atmosphere, at temperatures of 1575 to 1650^{0}C in platinum crucibles, cast into patties, and annealed at 550 to 650^{0}C. Chromium was batched as Cr_2O_3. Titania was added as a nucleating agent to the orthosilicate compositions. It is difficult to optimize the composition and conditions to produce the optical ceramic material [1]. Sol-gel technologies open up new possibilities for the creation of optical ceramics at the low temperature.

The sol-gel process has been used for the preparation of Cr^{3+}/Cr^{4+} forsterite ceramic powders. The fumed silica (aerosil) modified by Cr_2O_3 nanoparticles was used for doping of Mg_2SiO_4 yielding crystalline materials. One of the main advantages is low temperature of powder preparation (800-1000°C). This allows to control better the process of an optical ceramics synthesis.

The most popular methods of sol-gel synthesis are based on some modifications of alkoxide processes. Trivalent chromium in the form of $Cr(NO_3)_3 \cdot 9H_2O$ was introduced into silica gel monoliths, formed by sol-gel method using the system of $TEOS/H_2O/HNO_3$ in the molar ratio of 1:16:0.01. Gels were heat-treated up to 1150^{0}C. The UV-visible spectra of the glasses indicate only the presence of Cr^{3+} and absence of Cr^{4+} ions.

The glass-ceramics materials doped with Cr^{4+} ions have been fabricated on the base of monodisperse SiO_2 – sol, produced from orthosilicates (liquid glass) by the ion-exchange method and nanosized powders of Mg_2SiO_4. The sonoactivation will be used for homogenization colloid system and forming composition sol. After drying at 60 – 100 and thermal treatment at 1000 to 1400^{0}C the samples of glass-ceramic materials for studying of properties should be obtained. Analyzes of these ceramic materials exhibit absorption and near–IR emissions spectra characteristic of tetrahedral coordinated Cr(III) (fig.1) and Cr(IV) ions (fig.2). The methods of REM, APM, X-ray diffraction have been used for investigations of structural characteristics and morphology of the samples obtained.

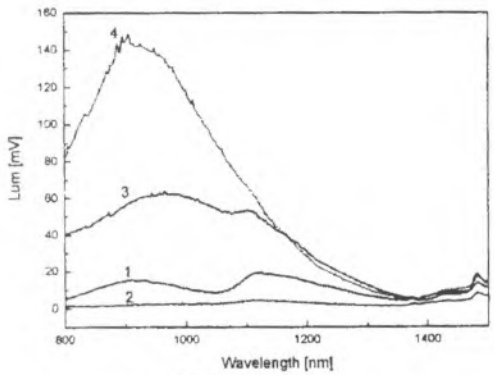

Fig. 1

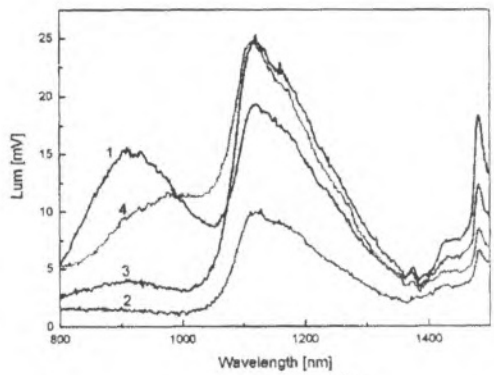

Fig. 2

1. L. R. Pinckney, G. H. Beall, Proc. SPIE, 4452(2001)93.