Optical Detection of Paramagnetic Centres in Activated Oxyfluoride Glass-Ceramics

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Oxifluoride glass-ceramics are transparent composite materials consisting of the oxide glass matrix and fluoride micro- and nanocrystals obtained by a thermal annealing of the initial oxyfluoride glass [1]. Activated oxyfluoride glass ceramics have found an application as infrared convertors [2], and are considered for applications as scintillators [3] and phosphors for white LED’s [4].

Activator centres as well as colour centres are often paramagnetic and may affect the properties of the glass-ceramics significantly. Investigations of the paramagnetic centres by the conventional electron paramagnetic resonance (EPR) techniques usually do not allow to directly attribute these centres to particular optical bands of the given sample. For this purpose the most convenient is optically detected EPR via the magnetic circular dichroism (MCD-EPR) [5,6].

MCD-EPR could be observed in the MCD bands which have paramagnetic behaviour. Paramagnetic MCD has been observed in the oxyfluorides activated by Mn$^{2+}$, Eu$^{2+}$, Gd$^{3+}$, Ho$^{3+}$, Sm$^{3+}$ and Er$^{3+}$. Oxyfluorides activated by Tb$^{3+}$ and Dy$^{3+}$ showed no paramagnetic components.

The results of the MCD-EPR measurements at the 377 nm and 521 nm MCD bands at the 1.5 K temperature for the oxyfluoride glass-ceramics showed that Er$^{3+}$ ions in the CaF$_2$ crystallites in these ceramics embed only in the cubic symmetry environment. These results are similar to the previous observations that the Gd$^{3+}$ ions in the glass-ceramics with CaF$_2$ also embed in the cubic environment [7]. For the SrF$_2$ containing glass ceramics the location of Gd$^{3+}$ in the cubic environment has been observed, too.

As a conclusion, in small CaF$_2$ crystallites (with the size of few tens of nm) the trivalent rare earth ions prefer to embed in the cubic symmetry environment.

Results of recent measurements on YAlO$_3$:Mn will be reported and compared with the Mn-doped oxyfluorides.

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