THE ANISOTROPY OF SCINTILLATION CHARACTERISTICS OF $CaMoO_4$

I. Solskii [a], D.M. Chernyak[b], F.A. Danevich [b], A. Luchechko [c], R.B. Podviyanuk[b], G. Stryganyuk [a], Ya. Zakharko [c]

[a] Institute for Materials, SRC "Carat", 202 Stryjska St., 79031 Lviv, Ukraine
[b] Institute for Nuclear Research, MNP 03680 Kyiv, Ukraine
[c] Faculty of Electronics, Ivan Franko National University of Lviv, 107 Tarnavskogo St, 79017 Lviv, Ukraine
e-mail: solskii@carat.lviv.ua

As it has been already demonstrated by several experiments scintillation detectors are promising tools to search for rare nuclear and subnuclear processes. Recently $CaMoO_4$ has been studied for possible use as a scintillation (cryogenic) detector to search for double β decay [1, 2] and dark matter [3, 4]. Further characterization of this encouraging material is important to its application in astroparticle physics.

Large $CaMoO_4$ single crystals (∅40×110 mm) were grown by Czochralski technique from platinum crucible in SRC "Carat" (Lviv, Ukraine). The crystals exhibit excellent optical quality and good light output. We have been measured spectral composition, light yield and decay time constant at different orientation of incident beam of laser radiation relatively to the crystal axis. The band with maximum at 320 nm placed in the fundamental absorption edge is dominant in the luminescence excitation spectra. Anisotropy of the decay kinetics is observed for the as-grown $CaMoO_4$ crystals. The decay time is found to be 9.6 μs at 293 K if the crystal axis is oriented parallel to the direction of the electric vector of exciting wave. After annealing of the crystal in the oxygen atmosphere the decay time increase to 19 μs and does not depend on the orientation.

Response to α particles was studied with $CaMoO_4$ crystal scintillator (annealed in oxygen atmosphere) by using collimated α particles of a ^{241}Am source. α/β ratio is 0.197(4) for 5.25 MeV α particles directed along to the [001] crystal axis. Three decay components were observed at the room temperature with $\tau_i \approx 1.5$ μs, ≈ 7 μs, and ≈ 25 μs by using transient digitizer with 20 MHz sampling frequency. No dependence of the α/β ratio and pulse-shape on direction of α irradiation relatively to crystal axes has been found.

The appropriate models of the luminescence centers, the scintillation mechanism and the origin of the decay time shortening in $CaMoO_4$ single crystals are discussed.

References

1. S. Pirro, et al., Phys. At. Nucl. 69 (2006) 2109.
2. A.N. Annenkov, et al., Nucl. Instr. Meth. A 584 (2008) 334.
3. V.B. Mikhailik, H. Kraus, J. Phys. D Appl. Phys. 39 (2006) 1181.
4. V.B. Mikhailik, et. al., Nucl. Instr. Meth. A 583 (2007) 350.