

CRYSTAL GROWTH AND STRUCTURE CHARACTERIZATION OF RARE EARTH DOUBLE TUNGSTATE

P. Iwanowski¹, V. Domukhovski¹, M. Berkowski¹

¹ Institute of Physics Polish Academy of Sciences, Warsaw, Poland

E-mail: iwanowskip@ifpan.edu.pl

Monoclinic KEr(WO₄)₂ (KEW) and KSm(WO₄)₂ (KSW) single crystals have been grown by the Top Seeded Solution Growth (TSSG) method. K₂W₂O₇ solvent containing up to 25% mol of crystallized compounds was used. This solvent is characterized by a very broad temperature range of crystallization, good transparency and it does not introduce additional ions into the flux. High purity materials: K₂CO₃, WO₃ and Er₂O₃ or Sm₂O₃ (respectively) were mixed and loaded in to platinum crucible 50x50mm, with 1 mm thick walls. The mixtures were homogenized by keeping the solution at the temperature of 30°C above saturation temperature for about 32 h. The temperature was stabilized at ±0.3°C. The radial gradient inside the solution was about 0.2°C/mm and vertical in the range 0.2 – 0.5°C/mm. The saturation temperature was found at 860°C and 920°C, respectively for KEW and KSW. Rotation rate decreased with increasing diameter of growing crystal from 50rpm at the beginning down to 20rpm. Crystals were pulled up at a rate of 1.5 mm/day. The cooling rate was 0.05°C/h at beginning and then was increased to hold proper diameter.

Structure analysis of obtained crystals was performed by X-Ray powder diffraction using Ni-filtered Cu K α radiation with a Siemens D5000 diffractometer. Data were collected in the angle range 20° < 2 θ < 144° with a step 0.02° and averaging time of 10s/step. The diffraction patterns were analyzed by the Rietveld refinement method. XRD measurements showed the symmetry of monoclinic space group C2/c. The unit cell parameters obtained for KEW crystals are a = 10.61554 Å, b = 10.31332 Å, c = 7.53631 Å, β = 130.750°, V = 625.058 Å³ and for KSW crystals are a = 10.72871 Å, b = 10.50827 Å, c = 7.62685 Å, β = 130.788°, V = 651.026 Å³.

References

- [1] E. Michalski, J. Zmija, Z. Mierczyk, A. Majchrowski, K. Kopczynski, S. Cichowski and J. Wojtanowski, Optical properties of doped potassium gadolinium tungstate single crystals, International Conference on Solid State Crystals 2000: Growth, Characterization, and Applications of Single Crystals, Proc. SPIE Vol. 4412, p. 69-73
- [2] M. T. Borowiec, V. P. Dyakonov, K. Woźniak, Ł. Dobrzycki, M. Berkowski, E. E. Zubov, E. Michalski, A. Szewczyk, M. U. Gutowska, T. Zayarnyuk and H. Szymczak, Crystal structure and magnetic properties of potassium erbium double tungstate KEr(WO₄)₂, J. Phys.: Condens. Matter 19 (2007) 056206