

Development and characterization of $K_2SO_4:Cu,Na$ phosphor for OSL method

Renata Majgier[#], Katarzyna Szufa, Agnieszka Balińska

Faculty of Science and Technology, Jan Długosz University, ul. Armii Krajowej 13/15, 42-200 Częstochowa, Poland

The study explores the impact of thermal processing and dopant concentration on the optically stimulated luminescence (OSL) efficiency of a newly developed $K_2SO_4:Cu,Na$ phosphor [1-3]. This phosphor demonstrates high sensitivity as a radiation detector under infrared stimulation (IRSL). $K_2SO_4:Cu,Na$ exhibits very high sensitivity for IRSL, and the addition of sodium as a co-dopant significantly enhances its dosimetric properties. Investigations involving OSL, thermoluminescence (TL), and X-ray diffraction (XRD) were conducted. The samples were synthesized with varying concentrations of the dopants and subjected to controlled thermal treatments to assess their effects on luminescence properties. The results reveal that both the dopant concentration and the annealing conditions (temperature and duration) play a critical role in the OSL signal of the phosphor. Optimal dopant concentrations (0.1 mol% Cu and 2 mol% Na) and thermal treatments (1000°C, 4 h) were identified, leading to the highest OSL efficiency. The most sensitive compositions were those with 0.1 mol% Cu and 2-3 mol% Na, while samples with 4 mol% Na showed reduced sensitivity but exhibited enhanced signal stability (lower fading). The OSL decay and glow curve shapes varied depending on the sodium concentration, which is attributed to the different contributions of traps responsible for the signal and the significant role of sodium in shaping the trapping structure and recombination pathways. The material demonstrated high sensitivity, with minimum detectable doses in the sub-milligray range. These findings offer valuable insights for the design and optimization of the $K_2SO_4:Cu,Na$ phosphor for use in radiation dosimetry applications.

[1] R. Majgier and A. Chruścińska (2025) *J. Lumin.* 286, 121444.

[2] R. Majgier (2026) *Radiat. Meas.* 191, 107603.

[3] R. Majgier and G. Okada (2026) *Luminesc.* 41, e70457.

corresponding author: renata.majgier@ujd.edu.pl