Photoluminescent properties of monoclinic HfO_2:Ti sintered ceramics in 16—300 K.

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Streszczenie

Luminescent properties of HfO_2:Ti ceramics were investigated in the 16–300 K range of temperatures. A red shift of a broad emission band from about 490 nm at room temperature to 520 nm at 16 K was observed. The room temperature emission was showed to consist of two overlapping bands. The shorter wavelength band intensity was strongly reduced below about 80 K. The variation of the emission peak position correlates with the variation of decay time of the luminescence which increases by a factor of about 250, between room temperature (6 μs) and 25 K (1.7 ms). In the 25–300 K temperature range the decay traces were practically monoexponential while below 25 K two clearly different components were observed with time constants of about 300–700 μs and ∼3–4.4 ms. What is more, with decrease of temperature from 25 to 16 K the shorter decay time component dominates the longer one. Nevertheless, an average decay time calculated for emissions below 25 K was still 1.65–1.7 ms. The analysis of experimental data suggests that the emitting center is, most likely, a four level system with the two lowest levels separated by about 734 cm^{-1}. The lower of these two levels is clearly a triplet as transitions starting from it are strongly forbidden. The higher, presumably a singlet, is thermally populated at temperatures above 80 K, contributing to the spectra (shorter wavelengths emission) and decays (shorter effective decay times). The experimental data were also analyzed in a frame of a simple model and a good agreement between an experiment and theory was achieved. A configuration coordinate diagram is also presented, showing the levels due to the Ti ion in 3+ and 4+ charge states taking part in the charge transfer (CT) excitation and emission processes.