

F AND F⁺ CENTRE LUMINESCENCE IN ALUMINA NANOPOWDERS

Marek Oja (presenting author), Eduard Feldbach and Marco Kirm

Institute of Physics, University of Tartu, W. Ostwald Str. 1, 50411 Tartu, Estonia

e-mail of presenting author: marek.oja@ut.ee

Aluminium oxide (Al₂O₃) is widely used technological material in the form of ceramics and single crystals. In addition to well-known and studied α -Al₂O₃ (see [1] and references therein), there are metastable polymorphs (δ , θ , γ etc.) known as transition alumina. The main difference between transition aluminas and α -Al₂O₃ is the difference in the structure resulting in different electronic properties. In α -Al₂O₃ all Al ions have only octahedral coordination (AlO₆ units), whereas in transition aluminas tetrahedral units (AlO₄) can be found. The number of occupied tetra- or octahedral sites varies for different polymorphs, which leads to remarkable differences in their properties. In α -Al₂O₃ there are well known defects F and F⁺-centres, which correspond to oxygen vacancy with two electrons or one electron, respectively. For α -Al₂O₃ these two luminescence centres with emissions at 3.0 (τ ~36 ms) and 3.8 eV (τ ~2.1 ns) have been well-studied by multiple authors (e.g. [2]) but their characteristics in transition aluminas are not well-known. In this work we study properties of the F and F⁺-centre luminescence in transition aluminas.

The studied objects were synthesized using plasma processing technique, combustion synthesis and aluminium oxidation (see [3,4] and references therein). According to the XRD analysis the samples had different phase composition and crystallite size. Low temperature time-resolved VUV spectroscopy with SR and cathodoluminescence were the main experimental methods used. The bands corresponding to F-centre was revealed due to slow luminescence decay and in other samples luminescence with fast ns-decay arising from F⁺-centre luminescence was identified. Electronic properties of transition alumina including positions of emission and excitation bands, changes in decay times for F⁺-centre and effects due to different phases and crystallite size will be discussed.

References

1. M. Kirm, G. Zimmerer, E. Feldbach, et al, *Phys. Rev. B.*, **60**, (1999) 502.
2. A. I. Surdo, V. S. Kortov, V. A. Pustovarov, *Rad. Meas.*, **33**, (2001) 587.
3. M. Oja, E. Feldbach, A. Kotlov, et al, *Rad Meas*, **56**, (2013) 411.
4. M. Oja, E. Töldsepp, E. Feldbach, et al, *Rad Meas*, **90**, (2016) 75.



Euroopa Liit
Euroopa
Regionaalarengu Fond



Eesti
tuleviku heaks