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Lanthanides doped upconversion metal oxide nanocomposites for solar cell application

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There has been a growing demand to develop low cost but efficient solar cell devices either to compete on an equal footing basis or to replace conventional multicrystalline photovoltaic cells. This has called for development of new advanced materials, new generation and configuration of solar devices. Because of this, photovoltaic industry has, in the past few decades, experienced rigorous transformation where traditional solar cells formed by compact semiconductor layers have been joined by new kinds of cells constituted by complex mixture of organic, inoroganic and solid or electrolyte materials and rarely rely on charge separation at nanoscale. In addition, new materials based on a combination of large bandgap semiconducting metal oxide, ceramic and metal oxide/sulfide nanocomposites that are transparent and conductive and have low electrical resistance are being developed to improve the power conversion efficiency of the new generation of solar cell devices. We synthesized rare-earths (Er^{3+}, Tm^{3+}, Yb^{3+}) doped Al_2O_3-TiO_2 metal oxide nanocomposites and examined their structure, particle morphology and photoluminescent properties. We demonstrated the intense infrared to visible upconverted luminescence in Al_2O_3-TiO_2 co-ativated with Er^{3+}-Tm^{3+} and Er^{3+}-Yb^{3+} when excited using the fibre coupled 980 nm laser. The mechanism responsible for upconversion that involves the sequential two photon absorption will be discussed. These materials were evaluated for use as upconversion layers in solar cells.

Biography

Martin Ntwaeaborwa is Professor of Physics at the University of the Free State in Bloemfontein, South Africa. He has published more than 190 articles and has given numerous invited talks at local and international conferences. He is the Director of UNESCO-TWAS Centre of Excellence for advancement of science in developing countries.

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