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Energy-Sensitive Ion- and Cathode-Luminescent Radiation-Beam Monitors Based on Multilayer Thin-Film Design

A multilayer luminescent design concept is presented to develop energy sensitive radiation-beam monitors on the basis of colorimetric analysis. Each luminescent layer within the stack consists of rare-earth-doped transparent oxides of optical quality and a characteristic luminescent emission under excitation with electron or ion beams. For a given type of particle beam (electron, protons, α particles, etc.), its penetration depth and therefore its energy loss at a particular buried layer within the multilayer stack depend on the energy of the initial beam. The intensity of the luminescent response of each layer is proportional to the energy deposited by the radiation beam within the layer, so characteristic colour emission will be achieved if different phosphors are considered in the layers of the luminescent stack. Phosphor doping, emission efficiency, layer thickness, and multilayer structure design are key parameters relevant to achieving a broad colorimetric response. Two case examples are designed and fabricated to illustrate the capabilities of these new types of detector to evaluate the kinetic energy of either electron beams of a few kilo-electron volts or α particles of a few mega-electron volts[1,2].

[1] J. Gil-Rostra, F.J. Ferrer, J.P. Espinós, A.R. González-Elipe, F. Yubero, ACS Applied Materials and Interfaces 9, 16313 (2017). http://dx.doi.org/10.1021/acsami.7b01175

[2] F.J. Ferrer, J. Gil-Rostra, A.R. González-Elipe, F. Yubero, Sensors and Actuators A: Physical 272, 217 (2018). https://doi.org/10.1016/j.sna.2018.01.062

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