Using $Gd_2O_3:Bi^{3+}$ co-doped Ln^{3+} phosphors for enhancing the efficiency of silicon solar cells

Recently, luminescence materials were applied to enhance the energy conversion efficiency of solar cells (SCs) as a means to generate sufficient and clean energy. Low energy photons are not absorbed by a solar cell while high energy photons are not used efficiently. This causes to the loss of a lot of energy in the conversion of solar energy to electricity. This is the so-called spectral mismatch, which leads to the low efficiency of SC. To reduce the spectral mismatch losses, down-shifting (DS), down-conversion (DC) and up-conversion (UC) are using as good viable options. Most previous researchers presented results for rare-earth ions doped with inorganic materials as candidates for the DS, DC and UC processes. Previous research on Gd_2O_3:Bi co-doped with Yb^{3+} and Er^{3+} showed promising results for DC and UC applications and enhancing the efficiency of c-Si solar cells. The main goal of our study is to examine the application of Gd_2O_3:Bi co-doped with Yb^{3+} and Er^{3+} phosphor as powders and thin films for achieving external quantum efficiencies greater than unity and enhancing the conversion efficiency of silicon solar cells by using the DC and UC mechanisms.

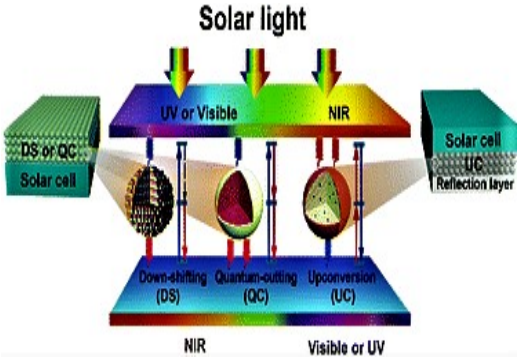

Figure 1. Spectral conversion design for photovoltaic device applications including downshifting (DS), down-conversion (DC) and up-conversion (UC) luminescent materials.

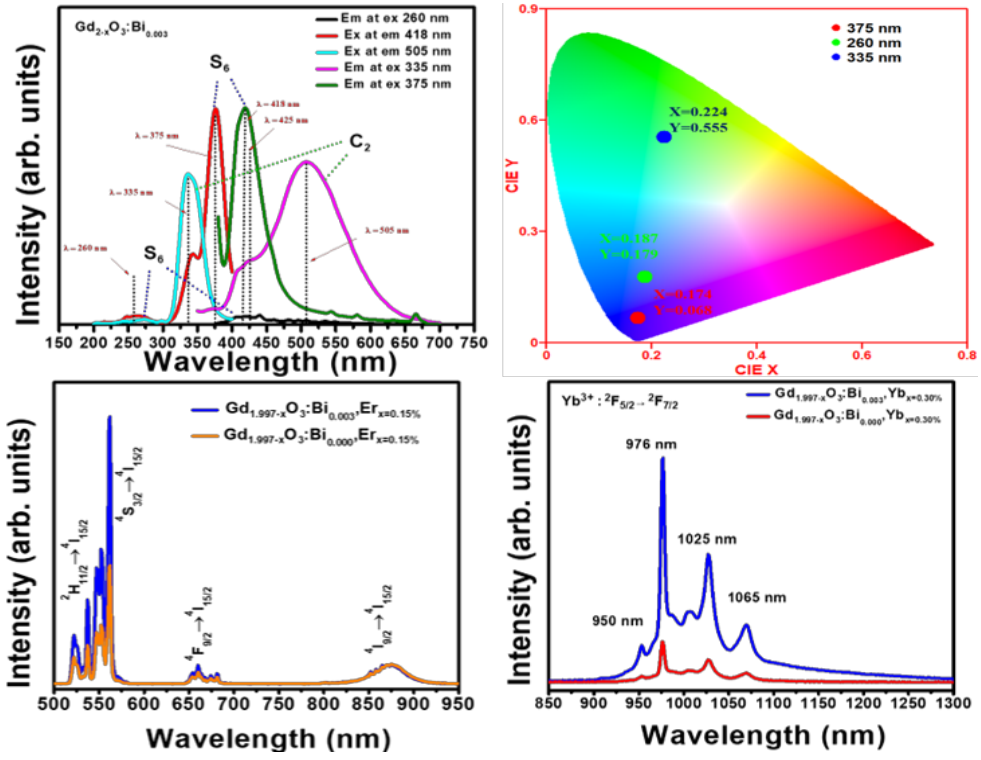

Figure 2: Some photoluminescence results for the Gd_2O_3:Bi and Gd_2O_3:Bi co-doped Yb^{3+} and Er^{3+} powder as DC and UC materials.