Point defects creation and their influence on luminescent properties of 0D, 1D, 2D and 3D materials

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The scintillators are the transformers of high energy incident radiation to low energy photons. In particular, they are used as radiation detectors in positron emission tomography (PET) or computed tomography (CT). Improved sensitivity and timing characteristics of the scintillating detector result in the decreased radiation dose delivered to a patient. Zinc oxide (ZnO), gallium nitride (GaN), cesium lead bromide ($CsPbBr_3$, CPB) and cesium copper iodide ($Cs_3Cu_2I_5$, CCI) exhibited great potential as the detector materials in PET and CT applications.

ZnO has excellent physical properties. It is cheap and can be easily grown as a nanopowder, in the form of free-standing nanorods or nanorods deposited onto a substrate.

GaN has scintillating properties very similar to those of the ZnO. It can be synthesized in the variety of forms as well. One of the forms is indium doped GaN (InGaN) multiple quantum wells (MQW) grown on a GaN layer - a kind of thin film multilayer structure, where the thickness of a single layer is about 2-3 nm.

CPB grown as larger nanoparticles or quantum dots has prominent timing characteristics, large light and quantum yields.

It is known that the 0D polyanionic inorganic networks like CCI:Tl(In) support the exciton emission reaching very high photoluminescence quantum efficiency (PLQE) of about 80-90%. Moreover, the high light yield (LY) of 50000-90000 ph/MeV [1,2] can be reached there. Remarkably, the growth of the undoped and Tl doped $Cs_3Cu_2I_5$ in the form of thin film exhibited scintillation efficiency at the level of one third of that of CsI:Tl whereas the afterglow was by about one order of magnitude weaker as compared to the CsI:Tl [3].

All of these materials suffer from intrinsic and extrinsic defects participating in luminescence processes and charge trapping phenomena affecting LY and PLQE. Therefore, knowing the defects types is very important. This is the aim of the present work.

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