Photoluminance Intermittency (Blinking) of Organic Lead bromide Perovskite Micro-crystals

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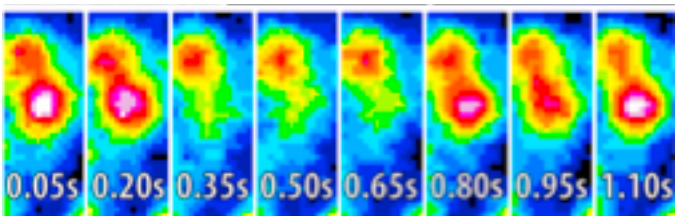
Organic-inorganic hybrid perovskites have emerged as one of the most promising materials for Photovoltaic applications. The efficiency of these perovskite based solar cells has rapidly improved to 22.1% in less than a decade. However, inconsistent performance of perovskite based devices in different operating conditions has led to considerable interest within the scientific community to investigate the various properties of these potential materials using advanced characterization techniques.

Among the various characterization methods, wide-field photo-luminance (PL) imaging is considered as a powerful tool to investigate the optoelectronic properties of these materials. So far, it has been extensively used to study the spatial distribution of defect density, recombination dynamics in isolated nano-particles and thin films of perovskite materials. An interesting random fluorescence intermittency (or Blinking) has recently been reported for perovskite nano-particles by this microscopy technique. Sudden increase (ON state) or decrease (OFF state) of PL intensity of the particles with time is the characteristics of such blinking phenomenon. Defect states created by non-bonded surface species are considered to be the main responsible factor for this unusual PL feature. Recently, this blinking phenomenon is observed in large perovskite grains grown in thin film form. The present talk will put emphasis on the large area blinking of isolated micro-crystals of methylammonium lead bromide perovskite ($MAPbBr_3$) material using spatially resolved PL imaging technique.



We have carried out a detailed study on the room temperature PL imaging of solution processed $MAPbBr_3$ micro-crystals in air, oxygen and nitrogen environment with continuously varying (15-85% RH) relative humidity conditions. Blinking behavior of PL intensity in ambient air atmosphere is observed only above a critical relative humidity of 75%. . It is often found that the blinking behavior also get transmitted from originated micro-crystal to the neighboring conjugated micro-crystals. In oxygen atmosphere, this blinking behavior in humid environment is found at lower relative humidity (>65%) condition than air. In contrast, higher humidity condition (>85%) is required to induce PL blinking in case of nitrogen environment. From these experiments it is conceivable that adsorption of water molecules by organic cations from the surrounding environment could be the predominant cause for PL intermittency (blinking) of $MAPbBr_3$ micro-crystals. Some of the interesting results of this study will be presented in the talk.