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A Study on Changes in Detection Sensitivity of Indirect X-ray Detector by Adjusting 2D Nanoplatelet Aspect Ratio

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In this study, we evaluated an indirect X-ray detector having an organic active layer blended with two-dimensional (2D) cadmium selenide (CdSe) nanoplatelets (NPLs). Figure 1 shows the active layer was composed of poly[N-90-heptadecanyl-,7-carbazole-alt-5,5-(40,70-di-2-thienyl-20,10,30-benzothiadiazo-le)] (PCDTBT), phenyl-C71-butyric acid methyl ester (PC71BM), and CdSe NPLs. The PCDTBT and PC71BM formed an organic bulk-heterojunction. Nanocrystals (NCs) refer to small crystals having a range of nanometer sizes of at least one dimension. In particular, the 2D NPLs used in our experiment have the advantage of reducing the Auger recombination loss and enhancing charge carrier extraction by applying the quantum confinement effect in one direction [1]. Moreover, the CdSe NPLs can easily adjust the aspect ratio by changing the blending ratio of precursors and changing the aspect ratio can affect the optical and electrical characteristics. The PCDTBT:PC71BM solution was prepared in ratio of 1:4, and CdSe NPLs with different aspect ratios (6:1, 1:1 and 3:1 as shown in Figure 2(b)) were added. Figure 2 (a) shows the trend of X-ray detector parameters, such as Jsc, CCD –DCD and sensitivity, according to 2D NPLs blending effect. In the case of aspect ratio = 1:1 NPLs, the sensitivity showed 2.34 mA/Gy·cm2, which was increased by 15.3% compared to the pristine PCDTBT:PC71BM detector. The 2D NPLs added to the organic active layer enhanced the sensitivity by promoting carrier generation and transport.

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