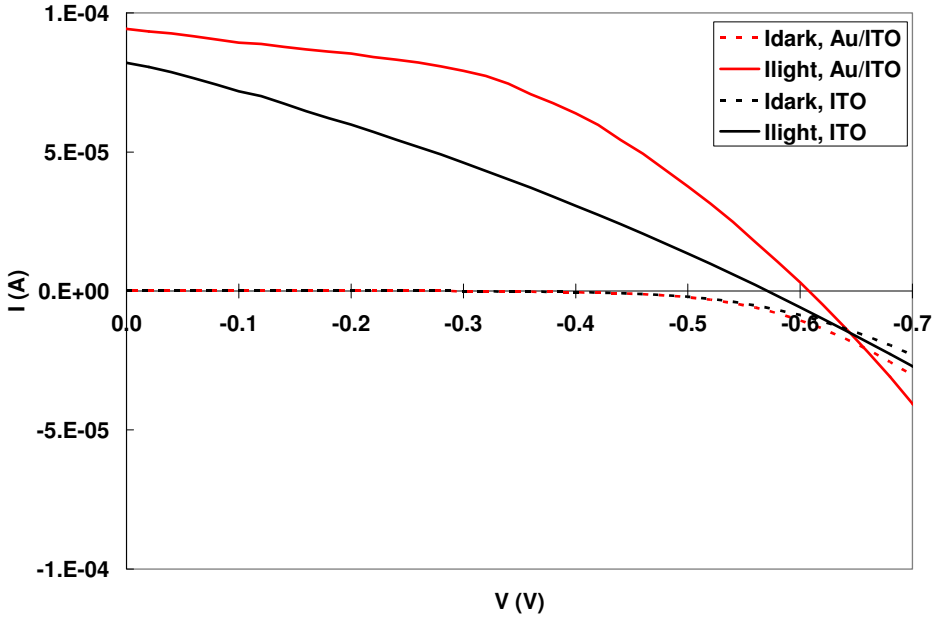

Fig. 5. I-V curves of FTO/TiO_2/PbS CQD/(ITO or Au/ITO) devices under 975nm illumination at 100 mW/cm^2.

975nm illumination device with and without a layer of Au between the ITO and PbS, the device performance is increased due to an increase in the series resistance and a decrease in the shunt resistance, as inferred by the slope of the I-V curves as they cross the voltage and current axes, respectively. Such an increase is encouraging, but a 2nm Au layer is unlikely to fully protect the underlying PbS layer, and a thicker layer ceases to be sufficiently transparent to allow illumination from the top. While it is likely that the film is damaged due to the harsh conditions during ITO deposition (Argon ion/atom bombardment, UV illumination from the plasma, heating or ballistic damage from the sputtered ITO particles, etc.), further investigation is required in order to better understand the nature of this damage and its cause. If this is the cause of the dead zone formation in these devices, it is believed that the inclusion of an optically transparent hole transport layer between the PbS and ITO may help reduce the damage incurred by the PbS during deposition.

4. Conclusion

Spectral EQE measurements, obtained by illuminating through either the top or bottom contact of a FTO/TiO_2/PbS CQD/ITO photovoltaic device, are shown to be a sensitive indicator of collection efficiency as a function of position in the device. By comparing these spectra with spectra calculated using the estimated carrier generation profile in our devices, together with reasonable values of IQE, depletion width, and diffusion length, it was found that a large 'dead zone' must be present at the top of the devices, just under the ITO contact. Such a dead zone would cause a catastrophic loss of efficiency for devices that are illuminated through this top contact. The origins of this damaged region in the device, and possible means of preventing its formation, will be the subject of future investigations.

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