

3-molecular-layers-thick J-aggregate Photoconductor

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Due to their record high absorption constant and narrow photoluminescence linewidth [1], thin films of J-aggregated cyanine dyes have been extensively studied with respect to their potential applications in novel opto-electronic devices, such as organic light emitting diodes, optical switches, and lasers. J aggregates' strong absorption is especially interesting for use in light sensing devices like a photoconductor. A J-aggregate film that is only a few nanometers thick, in conjunction with a dielectric mirror, has an ability to absorb almost 100% of incoming light [2] at normal incidence.

We demonstrate in this study an efficient lateral J-aggregate photoconductor. Our device structure is a bi-layer heterojunction consisting of an optically active 5 nm thick TDBC J-aggregate thin film, which serves as the primary exciton generation layer, and a 50 nm layer of zinc indium oxide (ZIO) underneath, which serves as a charge transport layer. The contacts which sit below the ZIO are series of gold interdigitated fingers photolithographically defined on glass. The bi-layer structure physically separates the light absorption and charge transport regions of the device, taking advantage of the J aggregates' unique optical properties and the ZIO's charge transport properties. We observe that the heterojunction significantly increases the efficiency of the device by assisting the dissociation of the excitons, similar to the work reported by J. Ho *et al* [3]. External quantum efficiency (EQE), defined as the change in number of electrons passing through the bi-layer device per incident photon is shown in Figure 1. EQE greater than 100 % suggests that the exciton recombination lifetime is greater than the transit time of the electrons passing through the device. The curve follows the absorption curve of ZIO and the J aggregates shown in the inset. Figure 2 shows the time response of the bi-layer device.

REFERENCES

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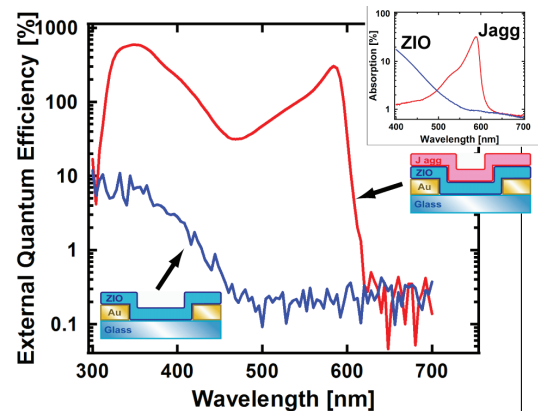


FIGURE 1: External quantum efficiency of the bi-layer device as a function of the incident light wavelength. The inset is the absorption curves of ZIO and TDBC J aggregates. The efficiency of the device is significantly improved where the J aggregates absorb light.

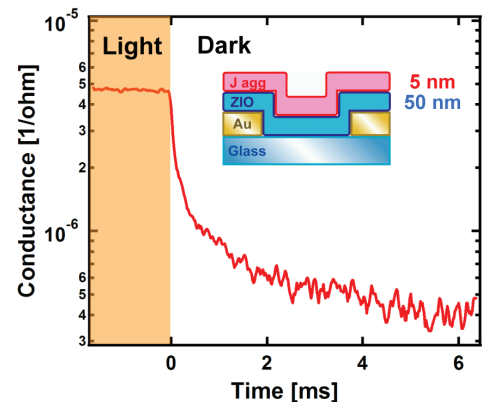


FIGURE 2: Time response of the bi-layer device using a LED light source peaked around 595 nm.