A Novel Ultra Thin Film Photovoltaic Technology with Alkali Metal Active Region

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The aim of this paper is to discuss the development of a novel ultra thin film photovoltaic technology which employs alkali metals [1] as key photoactive material to directly convert photons of light into electricity. Alkali metals possess the unique property among all the other elements in the periodic table of being able to be ionized by photons of visible light [2,3], which is the reason why they are the key component in vacuum photocathode-photomultiplier technology for high efficiency light detection. The proposed photovoltaic devices make use of an ultra thin photoactive alkali layer (<20nm) coupled with a tunnelling junction (<5 nm) of insulating material (i.e.: Si_2O) on top of which a high work function (~5eV) transparent electrode (e.g.: graphene, carbon, gold) is deposited, while on the alkali photoactive side an electron injecting transparent electrode (<20nm) is fabricated using a material with a work function lower than 5 eV (e.g.: Aluminium ~4.2 eV). The transparent electrodes allow visible light to reach the alkali photoactive layer and thus induce the emission of electrons, those emitted electrons are then able to pass through the tunnelling junction to reach the anode (whereas holes are blocked) and induce an electric current in the device due to the internal electric field created by the difference in the work functions of the different layers (Figure 1).

These novel photovoltaic devices have a theoretical quantum efficiency > 30%, and can be readily fabricated using standard physical vapour deposition techniques already employed in industry.

References

[1] Galbiati, “a thin film photovoltaic device with alkali metal active region”, patent GB2468526, (2010)

[2] Elster and Geitel, “*On the discharge of negative electric bodies by sun and daylight*”, *Ann. Physik*, Vol. **38**, (1889) pp. 497-514

[3] Albert Einstein , "*On a Heuristic Viewpoint Concerning the Production and Transformation of Light*", *Annalen der Physik* **17,** (1905) pp. 132–148

Figures

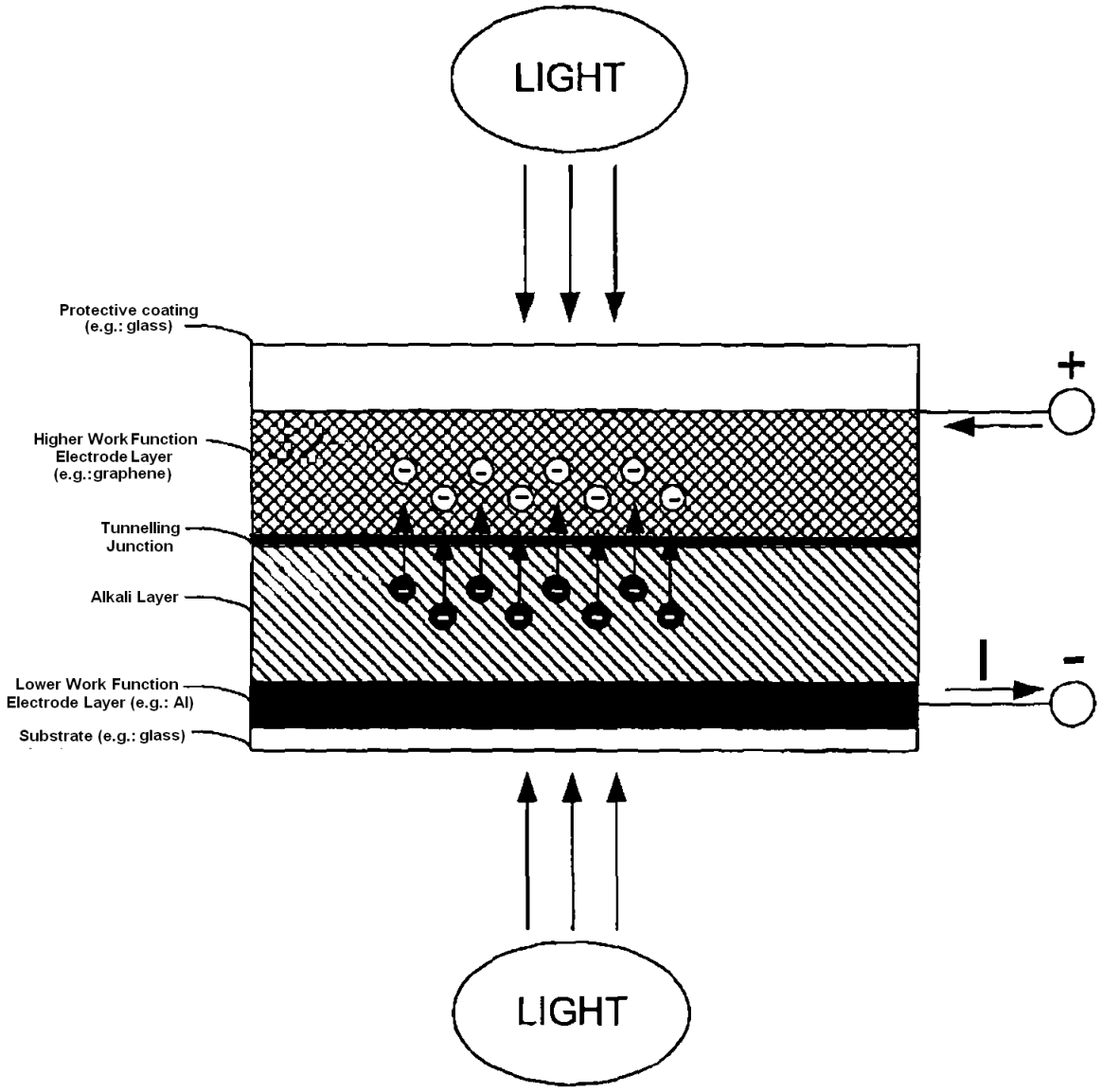

Figure 1 Sectional view of the structure of an ultra thin film photovoltaic device with alkali metal active region.