Organic/Inorganic Hybrid Perovskites: Towards Sustainable Water Splitting

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Sustainable energy resources have gained enormous research attention in recent years and there exists a need for achieving independence from fossil fuels. Among several sources, solar energy has the potential to satisfy all the needs of the world. This forms the motivation of the research work that is carried out in this project. With an emphasis on achieving cost-effective alternatives to silicon based solar cells, we have fabricated perovskite based solar cells that have recently shown to achieve close to 20% solar to light conversion efficiency. Two important things are addressed in this research work. Firstly, the studies were carried out to probe the influence of electron transporting material such as nanocrystalline TiO2, CeO2 (Ceria) and Ceria doped Zirconium on solar cell efficiencies. Secondly, to use the fabricated solar cells in a tandem geometry to achieve photo-catalytic water splitting. The approach was to use the higher efficiencies of solar cells and apply them directly to split water through electrolysis. With our efforts, solar cells with different electron conducting materials were fabricated and their solar cell efficiencies were determined. The results show that Ceria doped Zirconium was the best material among different electron transport materials followed by nano-crystalline TiO2 and Ceria. The results also show that reasonable efficiencies can be obtained from Ceria and Ceria doped Zirconium as electron transporting materials even though their surface roughness is limited. However, if nanocrystalline Ceria and Ceria doped Zirconium would be used, they can give similar solar cell efficiencies as that of nanocrystalline TiO2. Efforts are underway to use these solar cells in a tandem geometry to achieve photo-catalytic water splitting.