Chitosan: a promising material for the prevention of lead leakage in perovskite photovoltaic cells

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The global energy transition into renewable sources is becoming a pressing topic with new technologies being researched and entering the market. However, some of these new technologies still present some challenges. Photovoltaic power is one of the fastest growing sources of electricity and new alternatives to traditional silicon cells have been created [1][2]. Perovskite photovoltaic cells are one of such alternatives; they are promising yet the lead in its structure may leak into the environment when the cells get damaged [3][4]. Due to lead toxicity, this makes perovskite cells less appealing to the public. Until now, fossil based polymers have been used to try to solve this problem but with varying degrees of success. Additionally, their synthesis is still dependant on non-renewable raw materials which is seen as an important disadvantage. Thus, this work aims to take advantage of a bio-based polymer to improve the perovskite structural integrity. This contributes to a decrease in the amount of lead released into the environment if the cell is damaged and exposed to water, all while maintaining the high power conversion efficiency reported for perovskite photovoltaic cells. The base polymer chosen was chitosan due to its ability to interact with heavy metals and its abundance in nature [5]. Yet, it is not soluble in the common solvents used in perovskite manufacturing: dimethylsulfoxide (DMSO) and N,N'-dimethylformamide (DMF). Thus, chitosan was modified to turn it soluble in the desired solvents and also to increase its hydrophobicity, which can further protect the perovskite layer from being dissolved by water [6]. The modified chitosans that were soluble in DMSO or DMF were used to prepare films with perovskite. The films were submerged in water and the amount of lead released from the film was compared with the perovskite film without any polymer. The power conversion efficiency of the photovoltaic cells with the new polymers in the perovskite layer was determined and compared to the one obtained by cells without chitosan.

Keywords: Perovskite, Lead, Modified Chitosan

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