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MIXED HALIDE – HYBRID PEROVSKITE VIA AMBIENT REFLUX METHOD INSIGHT INTO STRUCTURAL, CHEMICAL AND OPTICAL PROPERTIES OF 2D HYBRID PEROVSKITE WITH DIFFERENCE CONCENTRATION OF HALIDIC ACID

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ABSTRACT

Recently, numerical simulation of hybrid perovskite solar cells has attracted scientific community and received great attention. Hybrid organic–inorganic perovskite materials have promising electro-optical properties such as broad optical absorption coefficients, long electron–hole diffusion lengths, high charge carrier mobilities and potentially low fabrication cost. They are also relatively easy to process. These properties have contributed to making hybrid organic–inorganic perovskites promising candidates for next-generation, low-cost solar cell absorbers. Among organic–inorganic perovskite solar cell (PSC) materials, methylammonium lead iodide ($CH_3NH_3PbI_3$ or $MAPbI_3$), is used as light harvester.It has an ABX3 structure (A is organic cation, B is divalent metal cation and X is halogen ion), and can be vapor and solution processed into perovskite solar cells (PSCs) which favourably compares to established photovoltaic (PV) technologies. However, their stability and durability are limited, especially when exposed to air and moisture. In an effort to improve the stability and durability of $MAPbI_3$ perovskite solar cells, new materials compositions have emerged. Moreover, perovskites with mixed halide compositions demonstrate attractive optical properties as the bandgap is tuned by varying the halide ion ratio (Cl:Br and Br:I). Next, in this thesis, we describe how hybrid perovskite based solar cells has become an important renewable source of energy along with historical background and the future of this potential material. We also describe the synthesis and fabrication methods for preparing ultrathin to bulk perovskites and their crystallographic nature of pure and mixed hybrid perovskite system. This review not only focused on properties of hybrid perovskite but also represents the drawback as well as the development and performance in different fields of application.

TABLE OF CONTENTS

CHAPTER 1

INTRODUCTION

1.1 Background of Study

Hybrid metal halide perovskites are new developing materials that have been utilised in photovoltaic (PV) technology in recent years. These are referred to as hybrids since they are made up of both organic and inorganic components. The first hybrid perovskite-based solar cells were published in 2009 (A. Kojima et al., 2009). The most often utilised hybrid perovskite materials as an absorber layer in perovskite solar cells (PSC) are methylammonium lead iodide ($CH_3NH_3PbI_3$ or $MAPbI_3$) and ($CH_3NH_3PbBr_3$ or $MAPbBr_3$) methylammonium lead bromide with bandgaps of 1.6 eV and 2.3 eV, respectively (J.H. Noh., 2013). In addition, the halide perovskite semiconductors have several inherent ideal properties that make them suitable for use in solar cells, including strong absorption in the visible region (T. Shi., 2014), long carrier diffusion lengths of up to ~1 nm (S.D. Stranks., 2013), a weak exciton binding energy of ~ 45 meV (E.A. Muljarov., 1995), high carrier mobility of ~25 $cm^2\ V^{-1}S^{-1}$, and a low charge recombination rate on microseconds time scale (C.S. Ponseca.,2014).

Beside that, the Perovskite materials have a general formulation ABX_3, where A site is commonly occupied by monovalent organic cation $CH_3NH_3^+(MA^+)$ or $CH(NH_2)^+(FA^+)$, B is a metal cation Pb^{2+} and X is a halide anion ($X = I^-, Cl^-, Br^-$) . It can be vapor and solution processed into perovskite solar cells (PSCs).

Moreover, because to its improved stability in an ambient environment, 2D perovskite has lately garnered considerable attention. Perovskite with a lower dimensionality (usually referred to as 2D perovskite) emerged as a particularly stable kind of hybrid perovskite. These two-dimensional perovskites are composed of a perovskite structure coated with an organic