

Effect of RP and DJ Spacers on the durability of Lead Halide Perovskites

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Lead halide organic–inorganic perovskite solar cells (PSCs) are promising for their high efficiency and low production costs, but their commercialization is hindered by limited durability [1]. Enhancing durability can be achieved by modifying perovskite with hydrophobic molecular spacers like alkyl or aryl ammonium halide salts, making the device more moisture-resistant [2]. There are two types of spacers: Ruddlesden-Popper (RP) with a single NH_3^+ group and Dion-Jacobson (DJ) with diamine cations [2]. Hereby, methylammonium lead halide perovskites (MAPI) were treated with a solution of butylammonium iodide (BAI) – RP spacer or 1,4-butanediammonium diiodide (BDAl_2) – DJ spacer in isopropyl alcohol, in different concentrations. The samples were spin-coated at 5000 rpm for 35 seconds and then thermally treated at 100°C for 5 minutes. Scanning electron microscopy image (Figure 1a) of MAPI treated with 5 mmol L⁻¹ BAI and BDAl_2 showed exfoliation of the perovskite. However, despite this modification, no peaks related to the 2D phase were observed for BAI perovskite via UV-vis spectroscopy (Figure 1b). These characteristic peaks only appeared for MAPI treated with 50 mmol L⁻¹ BAI and 5 mmol L⁻¹ BDAl_2 . Furthermore, the absorbance peak related to the 2D phase disappeared after a few days (Figure 1c), while the perovskite band remained, suggesting that the 2D phase had interconverted to the 3D phase. Photovoltaic parameters (Figure 1d and 1e) showed that perovskites treated with 5 mmol L⁻¹ BAI maintained power conversion efficiency (PCE) values close to those of MAPI, whereas samples treated with 50 mmol L⁻¹ BAI or 5 mmol L⁻¹ BDAl_2 exhibited lower PCE values. Current density follows the same trend.

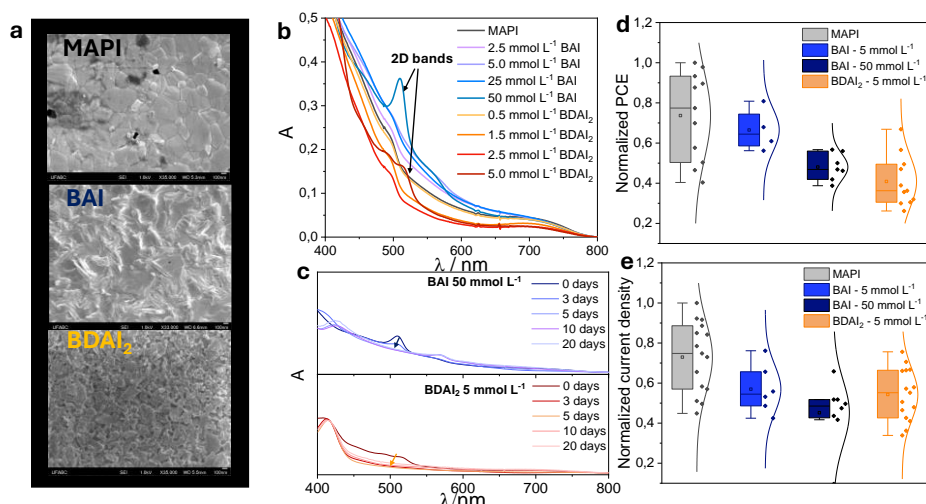


Figure 1. (a) SEM of samples, (b) absorbance of BAI and BDAl_2 samples at various concentration, (c) durability of 2D band, (d) normalized PCE and (e) current density.

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References

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