PÔSTER - RESUMO - DISPOSITIVOS OPTOELETRÔNICOS

ORIENTED INTERLAYER FOR IMPROVED CHARGE EXTRACTION AND STABILITY IN PEROVSKITE SOLAR CELLS

Carlos Henrique Stadtlober (Pd); Unicamp (carlosstadt@gmail.com)

Arthur Pignataro Machado (art.pmac@gmail.com)

Zeno De Castro Brandão (zenobrandao@gmail.com)

H. Bock (Pq); Crpp (harald.bock@crpp.cnrs.fr)

Paulo Ernesto Marchezi (pauloem@unicamp.br)

Juliana Eccher (juliana.eccher@ufsc.br)

Ivan H Bechtold (ivan.bechtold@ufsc.br)

Ana Flavia Nogueira (anafla@unicamp.br)

Perovskite solar cells (PSCs) have achieved remarkable progress in recent years, with power conversion efficiencies exceeding 27% [1], highlighting their strong potential for next-generation photovoltaic technologies. However, limited operational stability remains a major barrier to large-scale commercialization, particularly in inverted device architectures, where device degradation is strongly associated with metal electrode diffusion into the charge transport layers and the perovskite absorber. This diffusion leads to interfacial deterioration, increased recombination, and accelerated performance loss over time. In this context, cathode interfacial layers (CILs) play a crucial role in improving device performance and stability by optimizing energy-level alignment, passivating interfacial defects, enhancing electrode compatibility,

and suppressing charge recombination. Moreover, CILs can act as effective barriers against metal electrode diffusion into the underlying transport layers and the perovskite absorber [2]. Although bathocuproine (BCP) is commonly employed as a CIL due to its effective hole-blocking properties and ability to facilitate electron extraction, its limitations in terms of long-term durability motivate the search for alternative materials. In this work, we propose the use of an orientable columnar liquid crystal (ColLC) based on a benzo-perylene diimide derivative as a novel CIL for inverted PSCs, aiming to exploit its unique molecular organization to enhance charge transport along the extraction direction. These materials exhibit temperature-dependent mesomorphic properties that enable controlled molecular alignment. When confined between surfaces and heated near the isotropic phase, ColLC molecules become more fluid, allowing them to self-organize into a preferential face-on orientation. Previous characterizations revealed suitable energy levels, with a HOMO of 6.1 eV and a LUMO of 3.7 eV, confirming compatibility with CIL applications. Molecular alignment was verified by polarized optical microscopy, absorption, photoluminescence and electron mobility measurements. Furthermore, water contact angle measurements demonstrated higher hydrophobicity compared to conventional BCP, suggesting enhanced resistance to moisture-induced degradation and improved environmental stability.

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References:

[1] Zhuang Xiong et al., Homogenized chlorine distribution for >27% power conversion efficiency in perovskite solar cells. Science 390, 638-642 (2025). DOI: 10.1126/science.adw8780.

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Palavras-chave: solar cells; perovskite; organic interlayer; liquid crystal.