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All Bio-Phosphors for Highly Performing Low-Energy Bio-Hybrid Light-emitting Diodes

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Bio-phosphors have emerged as an alternative to rare-earth color down-converting filters in light-emitting diodes (LEDs). They are mainly produced with biogenic emitters, like Fluorescent Proteins (FPs), embedded in polymer matrices.^{1–3} The first bio-hybrid LED (Bio-HLED) with FP-phosphors featured a loss <10% of the emission intensity after 100 h.¹ This performance was recently enhanced using zero-thermal quenching PMMA-FP phosphors, reaching >150 days and 5 min of stability at low and high powers.⁴ However, the ideal combination of highly efficient and stable fully biogenic phosphors is still in its infancy.⁵ Here, we disclose the optimization of a bio-derived biodegradable polymer hosting and stabilizing a natural red FP – *mCherry*, as red-emitting phosphor in Bio-HLEDs. The photoluminescent properties of the bio-phosphors led to Bio-HLEDs with excellent photostabilities > 2000 h operating, representing 2 orders of magnitude enhancement compared to prior art. We are strongly convinced that our work represents a crucial breakthrough in the development of red emitting bio-phosphors and in the stabilization of further natural FPs.

1. Weber, M. D. *et al.* Bioinspired Hybrid White Light-Emitting Diodes. *Adv. Mater.* **27**, 5493–5498 (2015).
2. Fernández-Luna, V. *et al.* Deciphering Limitations to Meet Highly Stable Bio-Hybrid Light-Emitting Diodes. *Adv. Funct. Mater.* **29**, 1904356 (2019).
3. Aguino, C. F. *et al.* Single-Component Biohybrid Light-Emitting Diodes Using a White-Emitting Fused Protein. *ACS Omega* **3**, 15829–15836 (2018).
4. Espasa, A. *et al.* Long-living and Highly Efficient Bio-hybrid Light-emitting Diodes with Zero-thermal-Quenching Biophosphors. *Nat. Commun.* **11**, 1–10 (2020).
5. Fernández-Luna, V. *et al.* Biogenic Fluorescent Protein-silk Fibroin Phosphors for High Performing Light-emitting Diodes. *Mater. Horizons* **7**, 1790–1800 (2020).