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Optimizing Hydrogel Electrolytes for Dye-sensitized Solar Cells

Claudia Barolo^{a, b}, **Federico Bella**^c, **Simone Galliano**^a, **Lucia Fagiolari**^c, **Matteo Bonomo**^a, **Gerrit Boschloo**^d, **Michael Graetzel**^e, **Claudio Gerbaldi**^c, **Guido Viscardi**^a

^a Department of Chemistry, Università degli Studi di Torino, IT, Via Pietro Giuria, 7, Torino, Italy

^b ICxT Interdepartmental Centre Università degli Studi di Torino, IT, Lungo Dora Siena, 100, Torino, Italy

^c Department of applied science and technology (DISAT), Politecnico di Torino, Italy, Corso Duca degli Abruzzi, 24, Torino, Italy

^d Uppsala University, Ångström Laboratory, Sweden, Lägerhyddsvägen, 1, Uppsala, Sweden

^e Ecole Polytechnique Federale de Lausanne (EPFL), Lausanne, Switzerland

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Poster, Claudia Barolo, 270

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In this contribution, an investigation on bio-derived hydrogel electrolytes for dye-sensitized solar cells is proposed.

When opportunely developed and optimized, aqueous solar cells can be considered a truly low impact photovoltaic device with non-toxic components [1,2,3]. Moreover, the possibility of gelling the electrolyte into a polymeric matrix can reduce the leakage outside the device, thus increasing the long-term stability. Above all, bio-derived polymers appear promising being renewable and easy available with low cost [4]. Different aqueous electrolytes gelled with carboxymethylcellulose (Na-CMC) or xanthan gum have been prepared with both I-/I³⁻ and Co²⁺/Co³⁺ redox mediators. These gelled systems show good photovoltaic performances, maintaining over 90% efficiency of liquid DSSCs, as well as enhanced long-term stability.

Moreover, we demonstrate the use of Experimental Designs (DoE) as a powerful chemometric technique for the concurrent investigation of a number of experimental factors that directly influence the photovoltaic performances of solar cells. Results obtained enlighten that a solid mathematical-statistical approach is fundamental to support the researchers and effectively drive the experiments towards the achievements of optimal operating conditions for aqueous solar cells [5].

References:

[1] Bella, F.; Gerbaldi, C.; Barolo, C.; Grätzel, M. *Chem. Soc. Rev.* 2015, 44, 3431-3473

(<https://doi.org/10.1039/c4cs00456f>)

[2] Galliano, S.; Bella, F.; Gerbaldi, C.; Falco, M.; Viscardi, G.; Grätzel, M.; Barolo, C. *Energy Technol.* 2016, 5, 300-311

(<https://doi.org/10.1002/ente.201600285>)

[3] Bella, F.; Galliano, S.; Falco, M.; Viscardi, G.; Barolo, C.; Grätzel, M.; Gerbaldi, C. *Chem. Sci.* 2016, 7, 4880-4890

(<https://doi.org/DOI:10.1039/c6sc01145d>)

[4] Bella, F.; Galliano, S.; Falco, M.; Viscardi, G.; Barolo, C.; Grätzel, M.; Gerbaldi, C. *Green Chem.* 2017, 19, 1043-1051

(<https://doi.org/10.1039/c6gc02625g>)

[5] Galliano, S.; Bella, F.; Piana, G.; Giacona, G.; Viscardi, G.; Gerbaldi, C.; Grätzel, M.; Barolo, C. *Solar Energy*, 2018,

163, 251-255 (<https://doi.org/10.1016/j.solener.2018.02.009>)

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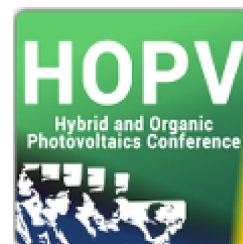
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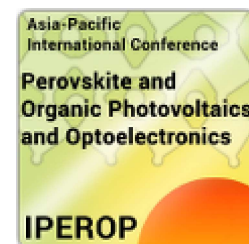
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