

Eumelanins: Mammal pigments for bioelectronics

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Eumelanins are the black insoluble pigments of human skin, eyes and substantia nigra (neuromelanin), featuring unique assortment of chemical physical properties, i.e. broadband absorption in the UV-visible range, intrinsic free radical character, water-dependent hybrid ionic–electronic conductor behaviour.¹ These pigments, arising biogenetically from the aminoacid tyrosine via the oxidative polymerization of 5,6-dihydroxyindole (DHI) and/or 5,6-dihydroxyindole-2-carboxylic acid (DHICA),¹ stand, today, as a unique source of inspiration for the design and implementation of soft biocompatible multifunctional materials for bio-optoelectronic devices. Interest in eumelanins stems from bioavailability, biocompatibility and their peculiar set of physicochemical properties, chiefly the electrical conductivity, which support optimistic feelings about a possible rise of eumelanin-mimics as innovative bioinspired solutions for organic bioelectronics. To date, a number of conceptual and technological gaps still hinder rapid progress of melanin-based organic electronics and bioelectronics, including in particular the limited contribution of electronic conductivity and current decay with time under biasing. Herein, we provide a concise overview of the structural and optoelectronic properties of melanins with a view to bringing to focus main issues and challenges en route to bioelectronic applications.² Basic structure-property function relationships, fundamental tailoring strategies, processing and the balance of ionic-electronic processes will be addressed along with representative examples of eumelanin-based hybrids to orient ongoing efforts toward efficient and competitive eumelanin-based technology.

Alessandro Pezzella received his Ph.D. in Chemistry in 1997 under the direction of Professor G. Prota at the University of Naples "Federico II". His research activities focused on the oxidative chemistry of 5,6-dihydroxyindoles, the melanin pigment characterization and the oxidative behavior of phenolic compounds associated with the molecular mechanisms underlying degenerative pathologies. More recently, in the context of several research projects on the applications of bioinspired polymers and heterocyclic compounds in organic electronics and bioelectronics, his research interests have embraced the development of synthetic strategies for substituted indoles and phenolic compounds. Pezzella's current interests centre on the chemistry of eumelanins and their processing within electronic devices as well as their employment as bioinspired interface for cell culture growth and sensing. His research activity has produced over 100 publications including international and national patents, research papers, reviews, and book chapters. Main research results are represented by the disclosure of endogenous neurotoxin formation path of relevance to biological environments; the definition of open issue in melanin research (solubility; structure; morphology); the opening of studies on eumelanin in organic electronics.

- (1) d'Ischia M., Wakamatsu K., Napolitano A., Briganti S., Garcia-Borron J. C. et al. (2013). Pigment cell & melanoma research, Vol. 26, p.616-633.
- (2) Berggren M., and Richter-Dahlfors A. (2007). Adv Mater, Vol.19, p.3201-3213.

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