Colloquium

Electrochemically Induced Asymmetry: from Molecules and Materials to Motion and Back

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Asymmetry is a very common feature of many systems, objects and molecules, that we encounter and use in our daily life. Actually, it is in the majority of the cases an absolutely crucial ingredient for conferring a certain useful property to an entity, a prominent example being the chiral nature of pharmaceutically active compounds.Chemists have developed various approaches to generate asymmetry, from the molecular to the macroscopic scale, and this seminar illustrates, with a series of selected recent examples, how electrochemistry can make original contributions to the topic.At the molecular level, it is possible to use specifically designed electrodes for the analysis1, separation2 and synthesis of chiral molecules3-5 with very high enantioselectivity.From a point of view of materials science, asymmetric so-called Janus objects with complex surface features can also be electrogenerated in a straightforward way, at the nano6,7- micro8-12- and macro-scopic13 scale.As asymmetry is also a mandatory attribute for inducing directed motion, electrochemical phenomena can be furthermore advantageously employed to fuel exogenous or endogenous hybrid dynamic systems, exhibiting interesting features when they are used for example as actuators14-18 or swimmers19-23.The latter can then in turn serve again for the efficient synthesis of chiral molecules24-26, thus closing the loop. References1. S. Butcha et al., Chem.Comm. 58 (2022) 10707; 2. S. Assavapanumat et al., Angew. Chem. Int. Ed. 58 (2019) 3471;3. S. Assavapanumat et al., J.Am.Chem.Soc. 141 (2019) 18870; 4. S Butcha et al., Nat. Comm. 12 (2021) 1314;5. S. Butcha et al., Chem. Sci. 13 (2022) 2339; 6. R. Gao et al., Nano Lett. 23 (2023) 8180; 7. R. Gao et al., ChemPhysChem 25 (2024) e202400257; 8. S. M. Beladi-Mousavi et al., Carbon 191 (2022) 439; 9. P. Chassagne et al., Adv.Mater. (2023) 2307539; 10. Y. Fu et al., Chem.Mater. 36 (2024) 7079; 11. B. Xie et al., Adv.Mater. (2025) 2506777 ; 12. K. Missaoui et al., Chem.Sci. (2025) 10691; 13. M. Ketkaew et al., Chem.Comm. 58 (2022) 10707; 14. L. Zhang et al., J.Am.Chem.Soc. 140 (2018) 15501; 15. S. Assavapanumat et al., Chem.Comm. 55 (2019) 10956; 16. S. Arnaboldi et al., Anal.Chem. 92 (2020) 10042; 17. B. Gupta et al., Chem.Sci. 12 (2021) 2071; 18. S. Arnaboldi et al. Nat.Comm. 14 (2023) 6390; 19. G. Salinas et al., Angew.Chem.Int.Ed. 59 (2020) 7508; 20. G. Salinas et al., Chem.Sci. 11 (2020) 7438; 21. G. Salinas et al., J.Am.Chem.Soc. 143 (2021) 12708; 22. S. Arnaboldi et al., Nat.Chem. 13 (2021) 1241; 23. C. Lozon et al., Angew. Chem. Int. Ed. 136 (2024) e202408198; 24. S. Arnaboldi et al., Angew.Chem.Int.Ed. 61 (2022) e202209098; 25. G. Salinas et al., Faraday Discuss. 247 (2023) 34; 26. Salinas et al., Curr.Opin.Electrochem. 49 (2025) 101612

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Raiffeisen Lecture Hall

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