Densely and selectively functionalized graphenes for energy storage and catalysis

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Selective and dense functionalization of graphene with redox-active, bioinspired, descrete molecular species or single metal atom ions can mitigate its tendency for restacking and boost interactions with target chemicals, combined with stability in challenging environments. Such properties are pre-requisites for sustainable electrode materials for energy storage and catalysis. By leveraging the susceptibility of fluorographene to nucleophiles, advanced and tailored graphene derivatives can be obtained for targeted applications. Graphene acid (GA), cyanographene (G-CN), superdoped graphene are indicative examples. GA bears carboxyls which are strong metal-coordination sites[1] and handles to immobilize aminoacids for development of catalysts for fuel production.[2] As Li-ion battery anode, GA reveals high redox capacity stemming from its carboxyl groups, and high conductivity.[3] The nitrile groups of G-CN mediate electronic communication between the graphene and metal ions, affording mixed valence Cu(I)-Cu(II) undercoordinated catalytic centres, enabling the effective production of pharmaceutical synthons via cooperative single-atom catalysis.[4] Nitrogen superdoping affords dense conductive electrodes with superior elelctroactivity and energy density in supercapacitors.[5] Such graphene derivatives lay the ground for the development of the next generation materials for energy storage, and catalysis but also for sorption, environmental monitoring and biomedical applications (Fig. 1).

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References

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Figures

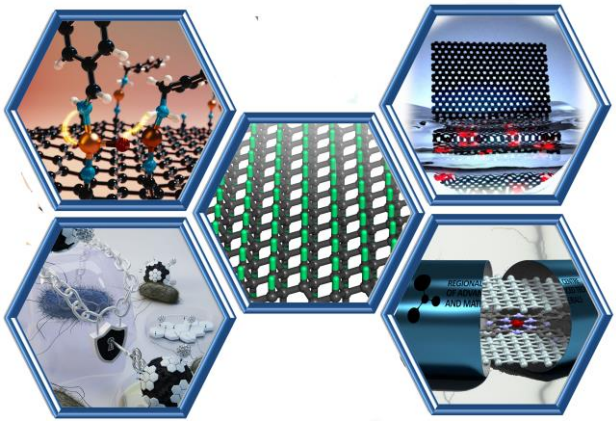

Figure 1: Fluorographene chemistry offers densely and selectively functionalized conductive materials for energy storage and catalysis.