Sustainable carbon: graphene water, nanotube water and eco friendly conducting rubbers, electrocatalysts and supercapacitors

Alain Pénicaud
George Bepete, Ferdinand Hof, Kai Huang, Katerina Kampioti, Eric Anglaret, Carlos Drummond

Centre de Recherche Paul Pascal, UMR 5031 CNRS, Université de Bordeaux, 33600 Pessac, France

penicaud@crpp-bordeaux.cnrs.fr

(i) Full exfoliation of graphite to form thermodynamically stable, negatively charged, graphene (graphenide) flakes in solution can be achieved by dissolution of graphite intercalation compounds (GICs) in low boiling point aprotic organic solvents under inert atmosphere.[1] Graphenide can be transferred to *degassed* water as single layer graphene. The organic solvent can then be evaporated to remain with an aqueous graphene suspension of ca 400 m^2/L concentration under ambient atmosphere. The Raman spectra (2.33 eV laser) collected in situ on such dispersions show typical signals of single layer graphene.[2-5]

(ii) Food waste can be transformed into graphitic carbon and renewable hydrogen using an innovative low energy microwave plasma process at industrial scale. The obtained nanocarbon is obtained through energy efficient transformation of methane resulting from decomposition of food waste.[6] After purification, well defined, high concentration aqueous dispersions of nanocarbons are obtained and characterized. They contain calibrated multilayer graphene particles. Conducting inks, films, rubbers and supercapacitors can be prepared from these dispersions.[7,8] Additionally electrocatalysts for oxygen reduction reaction (ORR) and oxygen evolution reaction (OER) made of Fe nanoparticules / nanocarbon composite have been prepared with these multilayer graphenic particles.[9]

References

[1] A. Catheline et al. Soft Matter, 12, 7882, (2012)
[2] G. Bepete, C. Drummond, A. Pénicaud, European patent, June 12, 2014, EP14172164
[3] G. Bepete et al.,, Nature Chemistry, 9, 347-352 (2017)
[4] G. Bepete, A. Pénicaud, C. Drummond, E. Anglaret, J. Phys. Chem. C, 2016, 120, 28204-28214
[5] G. Bepete et al., Phys. Status Solidi RRL, 1–5 (2016) / DOI 10.1002/pssr.201600167
[6] European community funded FP7 project PLASCARB. http://www.plascarb.eu/
[7] F. Hof, K. Kampioti, K. Huang et al. Carbon 111 (2017) 142-149.
[8] K. Kampioti et al., ACS Omega, 2018.
[9] F. Hof et al. Chemistry, a European Journal, 2017, 23, 15283-15288

Figures

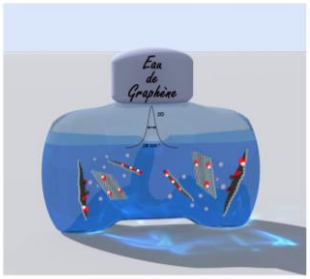

Figure 1: a scheme of graphene layers stabilized by OH- adsorption

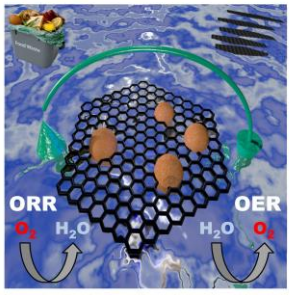

Figure 2: A scheme of nanographene / nanoparticle constituting an efficient electrocatalyst.