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Surface multi-functionalization of carbon fibres by novel plasma surface engineering technologies

Carbon fibres (CFs) are leading reinforcements in composite materials but the weak fibre/matrix interface adhesion becomes a barrier to further increase the mechanical properties of composite materials; carbon nanofibers (CNFs) have attracted much attention for electrodes of energy storage devices, but how to increase their performance presents a major technical challenge. To this end, some new plasma surface engineering technologies have been developed at the Birmingham Surface Engineering Research Group to multi-functionalize carbon fibre surfaces. This talk will start with the recent development of innovative plasma surface engineering technologies. The potential of these new plasma technologies will be demonstrated by way of examples including, (i) plasma activation and functionalization of CF surfaces by increasing their surface roughness, removing weakly bonded layers, altering their surface chemistry and enhancing their wettability and (ii) triple-glow plasma activation and deposition of metal nanoparticles to confer new and/or enhance surface properties and electrochemical performance (such as significantly increased capacity).

Recent Publications

1. Lin K, Li X, Dong H, et al. (2018) Nitrogen mass transfer and surface layer formation during the active screen plasma nitriding of austenitic stainless steels. *Vacuum* 148:224–229.
2. Corujeira Gallo S, Charitidis C A and Dong H (2017) Surface functionalization of carbon fibers with active screen plasma. *Journal of Vacuum Science and Technology A* 35–021404.
3. Corujeira Gallo S, Li X, Futterer K, Charitidis C A and Dong H (2017) Carbon nanofibers functionalized with active screen plasma-deposited metal nanoparticles for electrical energy storage devices. *ACS Applied Materials & Interfaces* 9(27):23195–23201.
4. Corujeira Gallo S and Dong H (2017) Effect of microstructure on the plasma surface treatment of carbon fibres. *Journal of Composites Materials* 51(23):3239–3256.
5. Lin K, Lu Y, Du S and Dong H (2016) The effect of active screen plasma treatment conditions on the growth and performance of Pt nanowire catalyst layer in DMFCs. *International Journal of Hydrogen Energy* 41(18):7622–7630.

Biography

Hanshan Dong received his PhD degree in Surface Engineering in 1997 and became a full Professor in 2010 at the University of Birmingham, Birmingham, UK. He is a leading Surface Engineering Expert in developing novel surface engineering technologies (S-phase surface engineering of corrosion resistant alloys, ceramic conversion of Ti- and Zr-based alloys, plasma multi-functionalization of carbon-based nano-materials, combined surface alloying and patterning for high-efficacy antibacterial surfaces, and low-friction and anti-adhesion coatings), surface designing and modelling and in characterizing surface engineered materials using environmental nanoindentation, FIB/SEM and XTEM. In addition to six patents, he has about 300 papers published (including 200 journal papers).

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