Two-dimensional polymer nanosheets for planar micro-supercapacitor-sensor integrated system

With the support by the National Natural Science Foundation of China and National Key R&D Program of China，the research team led by Prof. Wu ZhongShuai（吴忠帅），in collaboration with the team led by Prof. Feng Liang，at Dalian Institute of Chemical Physics，Chinese Academy of Sciences，reported the rational synthesis of two-dimensional hierarchical ordered dual-mesoporous polypyrrole/graphene nanosheets for the planar micro-supercapacitor-sensor integrated system，which was published in *Adv Funct Mater*（2020，DOI：10.1002/adfm.201909756）.

With upcoming booming popularity of flexible and wearable microelectronics，Internet of Things and self-powered microsystems，it is urgent to develop new-concept，high-performance microelectrochemical energy storage devices and their integrate systems. To address the poor compatibility of micro-supercapacitors and sensors in the emerging integrated systems，this team developed a two-dimensional hierarchical ordered dual-mesoporous polypyrrole/graphene nanosheet as bi-functional active materials for the prototype planar integrated system of micro-supercapacitors and NH_3 sensors. Owing to the effective coupling of conductive graphene and high-sensitive yet pseudocapacitive polypyrrole，well-defined dual-mesopores of ～7 and ～18 nm，hierarchical mesoporous network，and large surface area，the as-prepared nanosheets exhibit extraordinary sensing response to NH_3 as low as 200 ppb，and outstanding capacitance of 376 F g^{-1}. Notably，the resulting micro-supercapacitor-sensor integrated system represents rapid and stable response exposed to 10—40 ppm of NH_3 only after charging for 100 s，remarkable sensitivity of NH_3 detection，similar to micro-supercapacitor-free sensor，impressive flexibility with ～82％ of initial response value at 180°，and exceptional overall compatibility，thereby holding great promise for ultrathin，miniaturized，body-attachable，and portable detection of NH_3.
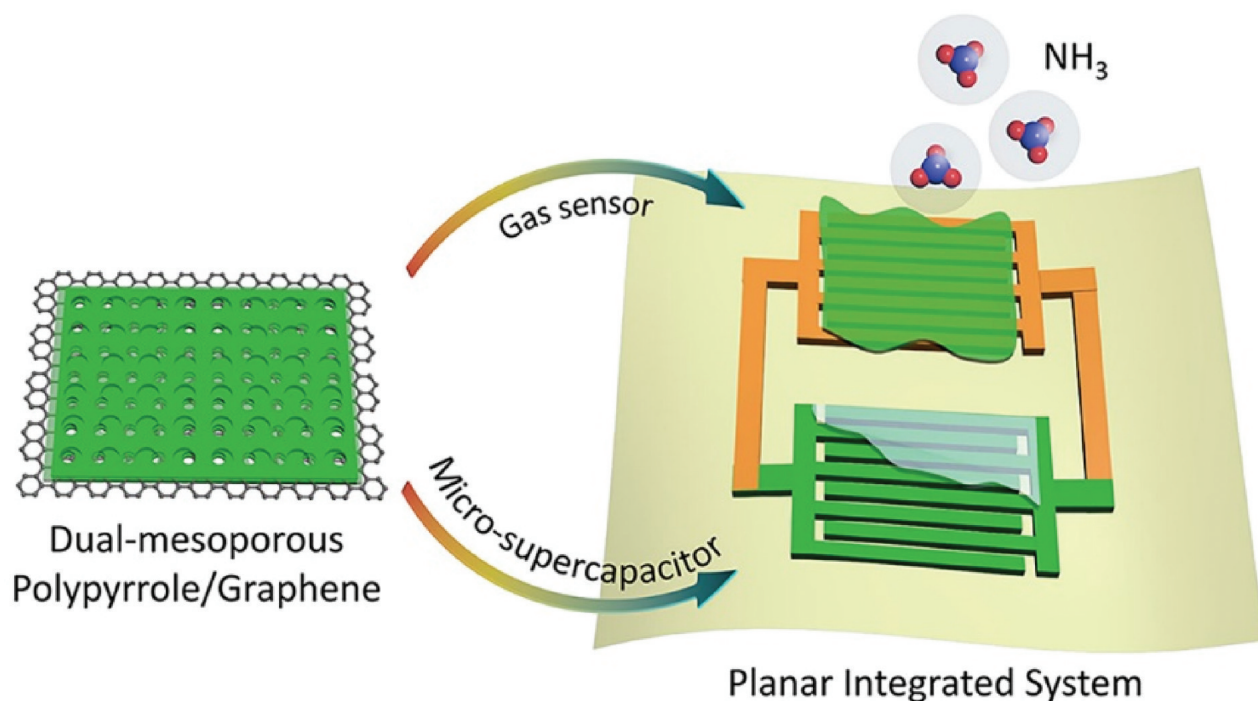

Figure Two-dimensional polymer for the planar micro-supercapacitor-sensor integrated system.