Autonomous Micromotors Based on Catalytically Pneumatic Behavior of Balloon-like MnO$_x$/graphene Crumpled

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Synthesis of MnO$_x$/graphene crumpled

GO was synthesized from natural graphite flake (325 mesh, 99.8%, ABR GmbH & Co. KG) by a modified Hummers method. The MnO$_x$/graphene crumpled were synthesized by the ultrasonic spray pyrolysis method. Briefly, graphene of 2mg/ml and KMnO$_4$ of 4mM were dispersed in water under ultrasonic oscillator of 90% power for 2.5 hour at room temperature. Then a homogeneous dispersion was gotten. The mixture was poured into the ultrasonic atomizer (2.4MHz, 241TM, Sonaer). The colloidal droplets sprayed from the precursor were blew through the tubular furnace by nitrogen at 300$^\circ$C. The speed of the N$_2$ was 1.5 L/min. Then the aluminum foil was placed at the end of the tubular furnace to collect the MnO$_x$/graphene crumpled.

The morphology and microstructure of the samples were investigated by SEM (Hitach S-4800 field emission scanning electron microscope), TEM (Tecnai G2 F20 S-Twin) and HRTEM (Tecnai G2 F20 S-Twin). The XRD (X’Pert-Pro MPD (Cu-Ka)) were used to analyse the crystal from of the MnO$_x$. At last the characterization of the
MnO$_x$/graphene crumples was observed by microscope (Olympus BX51) and through the method of making a model.

![Figure S 1. MnO$_x$/graphene crumples of different batches synthesized at 300°C when the ratio of KMnO$_4$ was 4mM.](image)

![Sample](image)

Figure S 2. An image of one Balloon-like micromotor moving along one direction captured from ESI video # 1.