Área: ELE
(Inserir a sigla da seção científica para qual o resumo será submetido. Ex: ORG, BEA, CAT)

Nº de Inscrição: 1302
(Inserir o número de inscrição do autor que fez a submissão)

Enhanced energy storage of Fe_3O_4 nanoparticles embedded in N-doped graphene

<u>Susana Chauque</u> (PQ),[1] Adriano H. Braga (PQ),[1] Renato V. Gonçalves (PQ),[2] Liane M. Rossi (PQ),[1] Roberto M. Torresi (PQ),[1*]

<u>susanachauque@gmail.com</u>; rtorresi@iq.usp.br

[1] Departamento de Química Fundamental, Instituto de Química, Universidade de São Paulo, USP, Brazil [2] Instituto de Física de São Carlos, Universidade de São Paulo, USP, São Paulo, Brazil.

Fe_3O_4 nanoparticles, Lithium-ion battery, Negative electrode, N-doped graphene.

Highlights

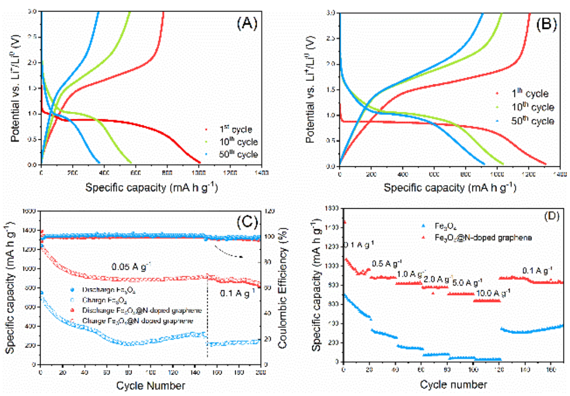
An Fe_3O_4 nanoparticles embedded in nitrogen-doped graphene was obtained.

Fe_3O_4@N-doped graphene exhibits an excellent cycling and rate performance.

N-doped graphene sheets allow to diminish the volume change of Fe_3O_4 during cycling.

Resumo/Abstract

Here, we report the synthesis and application of a hybrid material composed of Fe_3O_4 nanoparticles embedded in nitrogen-doped graphene sheets (Fe_3O_4@N-doped graphene) as a negative electrode for lithium-ion batteries. We studied the influence of N-doped graphene on the storage capacity of Fe_3O_4 using different electrochemical techniques. We determined that the as-prepared Fe_3O_4 materials presented high-quality crystalline nanostructures. Using cyclic voltammetry and electrochemical impedance spectroscopy techniques, we demonstrated that the N-doped graphene sheets improved the conductivity between the Fe_3O_4 nanoparticles, allowing a faster charge transfer process than that for pure magnetite nanoparticles, as well as the presence of porous particles in the hybrid composite. The Fe_3O_4@N-doped graphene hybrid material showed the best Li storage capacity and maintained specific capacity values of 910 mA h g^{-1} during the first 150 cycles performed at 0.05 A g^{-1} and 850 mA h g^{-1} at 0.1 A g^{-1} during the following 50 cycles, which were near their corresponding theoretical values. Moreover, the N-doped graphene sheets resisted the volume changes that occur during discharge/charge processes, which helped avoid the consequent pulverization that this kind of material suffers in rate capability experiments. We provided a simple and novel method to obtain a material with a higher superficial area and conductivity between particles, allowing great performance as a negative electrode for lithium-ion batteries application.



Galvanostatic charge/discharge profiles corresponding to cycle numbers 1 (red line), 10 (green line) and 50 (blue line) of Fe_3O_4 and Fe_3O_4@N-doped graphene (A) and (B), respectively. The tests were performed at 0.05 A g^{-1} (first 150 cycles) and at 0.1 A g^{-1} (the following 50 cycles) in a voltage range of 3.00-0.05 V vs. Li^+/Li^0 in a 1 mol L^{-1} $LiPF_6$ EC:EMC electrolyte. (C) Cycling performance and coulombic efficiency vs cycle number. (D) Rate capabilities at different charge current densities. Color code for (C) and (D): blue symbols correspond to the Fe_3O_4 material and red symbols to Fe_3O_4@N-doped graphene.

Agradecimentos/Acknowledgments

FAPESP (2015/26308-7; 18/11320-0), CNPq, CAPES.