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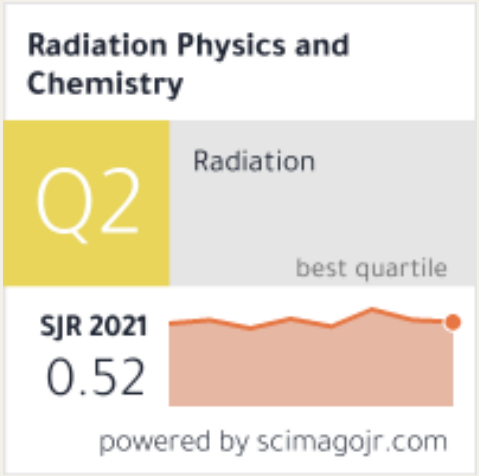

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Comparative study on the structural and electrochemical properties of nitrogen-doped and nitrogen and sulfur co-doped reduced graphene oxide electrode prepared by hydrothermal technique

Sarawudh Nathabumroong [a], Narong Chanlek [b], Thanapong Sareein [c], Ekachai Chongsereecharoen [d], Phakkhannan Pakawanit [b], Chatwarin Poochai [e], Tanachat Eknapakul [a], Chakrit Sriprachuabwong [e], Hideki Nakajima [b], Piyaporn Thangdee [a], Tanom Lomas [e], Saroj Rujirawat [b], Prayoon Songsiriritthigul [a], Prapan Manyum [a], Adisorn Tuantranont [e], Rattikorn Yimnirun [f,g,*]

[a] Reaserch Network NANOTEC-SUT on Advanced Nanomaterials and Characterization, School of Physics, Institute of Science, Suranaree University of Technology, Nakhon Ratchasama, 30000, Thailand
[b] Synchrotron Light Research Institute, Nakhon Ratchasima, 30000, Thailand
[c] Division of Industrial Materials Science, Faculty of Science and Technology, Rajamangala University of Technology, Phra Nakhon, 10800, Thailand
[d] Faculty of Science and Technology, Valaya Alongkorn Rajabhat University, Klong Luang, Pathum Thani, 13180, Thailand
[e] Graphene and Printed Electronics for Dual-Use Applications Research Division (GPERD), National Security and Dual-Use Technology Center (NSD), National Science and Technology Development Agency (NSTDA), 111 Thailand Science Park, Thanon Phahonyothin, Tambon Klong Nueng, Amphoe Klong Luang, Phathum Thani, 12120, Thailand
[f] School of Energy Science and Engineering, Vidyasirimedhi Institute of Science and Technology, Rayong, 21210, Thailand
[g] Research Network of NANOTEC-VISTEC on Nanotechnology for Energy, Vidyasirimedhi Institute of Science and Technology (VISTEC), Wangchan, Rayong, 21210, Thailand

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ABSTRACT

Nitrogen- and co-nitrogen- and sulfur-doped reduced graphene oxide (named N-rGO and N/S-rGO) was prepared by a simple hydrothermal technique using urea and thiourea as doping agents, respectively, to improve the properties of supercapacitor electrodes. Both were compared with rGO in electrochemical evaluations. The supercapacitor using N-rGO in 1 M H_2SO_4 provided the largest specific capacitance, 99 F g^{-1}, while those using N/S-rGO and rGO exhibited 51 and 19 F g^{-1} at 0.25 A g^{-1}, respectively. Furthermore, the supercapacitors using N-rGO and N/S-rGO electrodes showed a smaller charge transfer resistance (R_{ct}) and a lower *IR*-drop than those using the rGO electrode, indicating a faster charge transfer at the interface between electrode and electrolyte and higher electronic conductivity due to N or N/S heteroatom doping in the graphene oxide structure. Furthermore, the N-rGO electrode has a higher sp^2 hybridization ratio and a lower I_D/I_G ratio than the N/S-rGO electrode. Furthermore, the lowest contact angles of the N/S-rGO electrode were found, which was attributed to better aqueous electrolyte compatibility than the N-rGO and rGO electrodes. Therefore, the higher electrical conductivity of the N-rGO electrode reveals more relevant characteristics for high-performance supercapacitors than the good wettability of the N/S-rGO electrode.