Production of reduced graphene oxide from activated rice husk charcoal using a high-energy ball milling method

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First Author	
Last Author	
Authors	Widanarto, W; Romdhony, F; Cahyanto, WT; Sari, K; Ghoshal, SK; Kurniawan, C;
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Abstract	Production of high-quality graphene at a commercial scale with low cost remains challenging. Thus, we used a high-energy ball milling approach to make reduced graphene oxide (rGO) from activated rice husk charcoal as an enriched carbon source. The as-produced rGO samples were characterized to determine the effect of various milling times (0, 50, 100, 150, and 200 min) on their structure, morphology, specific surface area, pores volume, and size distribution. The variation in the ball milling times was found to introduce the structural defects and remove the oxygen functional groups, thus improving the overall characteristics of the obtained rGO. The wrinkle sheet-like structures of rGO evolved into numerous paper balls-like transparent rumple morphologies due to the milling process-enabled compression mechanism. In addition, due to the increase of milling times, the amount of carbon in rGO was increased to 89.9 atomic%, and oxygen was reduced to 9.3 atomic%, wherein the thermal agitation-mediated collisions of particles played a significant role. The specific surface area (121.483 m(2) g(-1)) and pore volume (0.133 cm(3) g(-1)) of rGO prepared at a milling time of 50 min were observed to be optimum. It was asserted that a high-energy ball milling technique with controlled milling times could help produce high-quality rGO from activated rice husk charcoal at low cost, leading to the development of sustainable and environmentally friendly material required for diverse applications.
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Author	WAHYU TRI CAHYANTO, S.Si, M.Si, Ph.D