

Adjusting C:SiO₂ Mole Ratios in Rice Hull Ash (RHA) to Control to Carbothermal Reduction to Nanostructured SiC, Si₃N₄ or Si₂N₂O

TECHNOLOGY NUMBER: 2021-449

OVERVIEW

A process to manufacture SiC and Si₃N₄ with elimination of impurities

- The reduction process does not require an extra carbon to preserve the original structure
- The composites may qualify as potential materials for Lithium batteries

BACKGROUND

Silicon Carbide (SiC) exhibits high thermal conductivity and has unique electronic properties that allow it to be used as semiconductor materials. Silicon Nitride (Si₃N₄) has high strength and fracture toughness at high temperatures, and it therefore has been used in a wide range of industrial applications. Traditionally, SiC and Si₃N₄ are produced by carbothermal reduction or nitridation of SiO₂ at high temperatures. Recent research has focused on using the Silicon Dioxide (SiO₂)-rich rice husk as the starting material in SiC and Si₃N₄ production. However, while this process produces SiC and Si₃N₄ with good purity, its commercial application is limited due to the production of impurities and agricultural wastes. So, a need exists for production of these compounds with a diminished production of impurities.

INNOVATION

Researchers have created a process to produce SiC and Si₃N₄ with good purity and which eliminates product impurities. This technology uses acid washed rice hull ash as starting material and then reduces SiO₂:C ratio by reacting with hindered diol, allowing for direct carbothermal reduction. The method for carbothermal reduction process which creates SiC, Si₃N₄, or Silicon Oxynitride (Si₂N₂O) without the need to add extra carbon as a mechanism to preserve the original nanocomposite structure. Acid and boiling water prewashing of RHA with milling also demonstrates another advantage through elimination of impurities compared to those found using conventional carbothermal reduction of agricultural wastes, which qualifies the composites as potential materials for Lithium batteries among other applications.

References

Technology ID

2021-449

Category

Hardware

Engineering & Physical Sciences

Author(s)

Eleni Temeche

Mengjie Yu

Richard Laine

Further information

Joohee Kim

jooheek@umich.edu

Learn more



1. Yu, Mengjie and Temeche, Eleni and Indris, Sylvio and Laine, Richard M. , Adjusting SiO₂:C mole ratios in rice hull ash (RHA) to control carbothermal reduction to nanostructured SiC, Si₃N₄ or Si₂N₂O composites, Green Chemistry, year 2021, volume 23, issue 19, pages 7751-7762. <https://doi.org/10.1039/D1GC02084F>