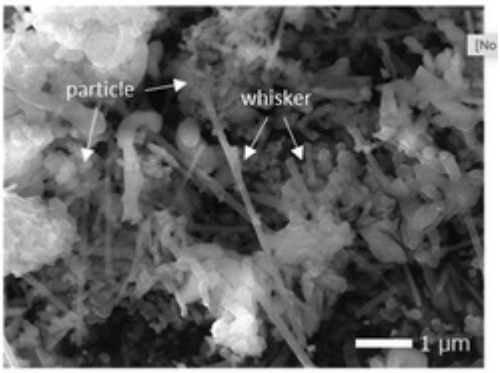
INNOVATION PARTNERSHIPS
UNIVERSITY OF MICHIGAN

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



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Hardware
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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 Si3N4are 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

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