

Development in Synthesis of Silicon Carbide from Natural Resource

by

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CERTIFICATION OF APPROVAL

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Approved by,

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

WAN IBRAHIM BIN WAN MAMAT

ABSTRACT

Silicon Carbide (SiC) is categorized as an important structural ceramic material because of its combination of excellence properties which are inherent due to highly covalent bonding. Composition of tetrahedral carbon and silicon atoms with strong bonds in crystal lattice resulted to very hard and strong SiC materials. Silica sands was chosen as the main resource of SiO₂ and being the most abundant natural resources available in Tronoh, Perak is used as major reference of the project. The most fundamental synthesis development of SiC is the reduction process of SiO₂ by carbonaceous material such as graphite and petroleum coke with addition of Al₂O₃ as additive. In this project, the development in synthesis of SiC from base materials silica oxide and graphite will be demonstrated using Low Energy Ball Milling and sintering techniques with significant low cost production and environmental concerns. The preparation for developing nano-crystalline particles of SiC is done by prolonged low energy milling process at constant speed of 100 rpm for 100 and 200 hours accordingly. The ball to powder weight ratio and operating speed are two key parameters of effective milling condition during milling and crucial introduce sufficient reaction energy to overcome the activation energy of SiC phase in the powder mixture. Throughout the experiment, comparison analysis between two time interval of milling on the X-ray diffraction (XRD) patterns has proven that the 200 h activated mixture revealed that SiC phase had been formed almost completely after reduction at temperature range from 1400°C to 1600°C. However, SiC crystalline has also developed during 100 h milling time with considerable amount. As the particle sizes and morphology behaviors are concerned, Field Emission Scanning Electron Microscopy (FESEM) was applied and finally revealed that the particle sizes of the powder mixture had been decreased from 63 μm to 300 nm due to the extending milling time. The SiO₂ particles had been covered by carbon particles and it is proven that the nano-particles of SiC whiskers were developed using this combination techniques

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LIST OF ABBREVIATIONS

Al ₂ O ₃	Chemical symbol for Aluminium Oxide
C	Chemical symbol for carbon
CVD	Chemical Vapor Deposition
FESEM	Field Emission Scanning Electron Microscopy
LPE	Liquid Phase Epitaxy
LPS	Liquid Phase Sintering
MA	Mechanical Alloying
M-PVT	Modified- Physical Vapor Deposition
PVT	Physical Vapor Transport
Si	Chemical symbol for Silicon
SiC	Chemical symbol for Silicon carbide
SiO ₂	Chemical symbol for Silica oxide
XRD	X-ray Diffraction