UNIVERSITI TEKNOLOGI MARA

SYNTHESIS, CHARACTERIZATION AND BAND GAP STUDIES OF η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ AND η-$Al_{1.9}Ni_{0.1}O_3$ NANOSTRUCTURED MATERIALS OBTAINED *VIA* SELF-PROPAGATING COMBUSTION (SPC) METHOD

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Thesis is submitted in fulfilment
of the requirements for the degree of
Master of Science

Faculty of Applied Sciences

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CONFIRMATION BY PANEL OF EXAMINERS

I certify that a Panel of Examiners has met on 30th April 2015 to conduct the final examination of Mawar Hazwani Binti Jasimin on her Master of Science thesis entitled "Synthesis, characterization and band gap studies of η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ and η-$Al_{1.9}Ni_{0.1}O_3$ nanostructured materials obtained *via* self-propagating combustion (SPC) method" in accordance with Universiti Teknologi MARA Act 1976 (Akta 173). The Panel of Examniners recommends that the student be awarded the relevant degree. The panel of Examniners was as follows:

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I declare that work in this thesis was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my work, unless otherwise indicated or acknowledged as referenced work. This thesis has not been submitted to any other academic institution or non-academic institution for any degree or qualification.

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ABSTRACT

η-Al_2O_3 is one of the metastable phases of aluminum oxide and known to be a very important support material for heterogeneous catalysts used extensively in the chemical industry. This phase is not easy to obtain. In this research, the η-phase is synthesized using a novel method, the self-propagating combustion (SPC) and the properties of η-Al_2O_3 and doped η-Al_2O_3 nanostructured materials were investigated. The synthesis parameters are optimized to obtain pure and single phase η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ and η-$Al_{1.9}Ni_{0.1}O_3$ nanomaterials. Materials characteristics inclusive of thermal behaviour, phase, stoichiometry structure, morphology and crystallite size were studied. Results showed that the substitution of Al with other metals (Ni, Fe) without changing the crystal structure affects the characteristics of material as well as their band energies.In this study, the effect of temperature on the phase formation of η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ and η-$Al_{1.9}Ni_{0.1}O_3$ were investigated. It was found that the annealing temperature has to be optimized to obtain pure η-phase. Pure and single phase η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ and η-$Al_{1.9}Ni_{0.1}O_3$ were successfully obtained by annealing for 24 hours at 700 ^{o}C to 850 ^{o}C, 700 ^{o}C to 800 ^{o}C, 700 ^{o}C to 900 ^{o}C, respectively. The band gap energies for η-Al_2O_3, η-$Al_{1.9}Fe_{0.1}O_3$ and η-$Al_{1.9}Ni_{0.1}O_3$ nanomaterials are between 6.29 to 6.55 eV, 3.26 to 3.19 eV and 5.6 to 5.96, respectively. Introduction of Fe^{3+} and Ni^{3+} ion in the η-Al_2O_3 material can narrow the band gap of the material. Thus, substitution of Fe^{3+} ions in the crystal lattice can result in the transformation of aluminium oxide material from insulator to semiconductor materials.

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