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Effect of pressure in post-hydrothermal treatment on the nanostructural characteristics of zno nanoparticles

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Abstrak

Zinc Oxide (ZnO) is an important semiconductor material due to its broad applications, such as in the fields of electronics, optoelectronics, photocatalysts, and solar cells. The main purpose of this work was to investigate the effect of pressure in post-hydrothermal treatment on crystallinity enhancement, crystallite growth, and band gap reduction of ZnO nanoparticles, which could be expected to improve their performance as the semiconductor oxide layer in the dye-sensitized solar cell application. For this purpose, ZnO nanoparticles have been successfully synthesized through the precipitation method, followed by a sequence of thermal treatments including drying, calcination, and Post-hydrothermal Treatment (PHT). For increasing the crystallinity of ZnO nanoparticles, PHT was carried out with a pressure variation of 1 and 3 bar. The resulting nanoparticles were further characterized with X-Ray Diffraction (XRD), Ultra-Violet Visible (UV-Vis) spectroscopy and a Scanning Electron Microscope (SEM). The study showed that by increasing the PHT pressure from 1 to 3 bar caused an adverse effect on the crystallinity, i.e. the crystallite size of ZnO nanoparticles slightly decreased from 27.42 to 26.88 nm. This was expected to be due to the increase of the boiling point of water causing less effective of vapor generated to improve the crystallinity by a cleavage mechanism on the inorganic framework. The band gap energy (Eg), however, was found to increase slightly from 3.25 to 3.26 eV, respectively. Considering the obtained properties, ZnO nanoparticles in this study have the potential to be used as the semiconductor oxide layer in the dye-sensitized solar cells.