

## Fe-doped ZnO Nanorods Prepared by Aerosol-assisted Chemical Vapour Deposition (*in-situ* doping) and their Photocatalytic Activity of in Degradation of RhB Dye

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### Extended Abstract

CVD is one of the most common vapour route technique uses by researchers to produce doped nanostructures. In this technique, the dopant precursor is normally mixed together with the precursors for the growth of nanostructures. The limitation of mixing both the dopant sources together with the Zn related precursor is that the dopant source must have a close evaporation/sublimation temperature with the Zn related precursor. This criterion is important to ensure a sufficient amount of dopant vapour is generated during the synthesis of nanostructures for *in-situ* doping purpose. In order to rectify the above problem, the dopant precursor and Zn related precursor are placed separately at different heating zone in the reactor. Although the doping efficiency might be able to improve via this arrangement, the above approach is limited to laboratory scale for producing doped nanostructures. Furthermore, it is difficult in controlling the doping concentration and duration, as well as lack of flexibility in choosing the suitable dopant precursor. Synthesis techniques such as MBE and MOCVD have great potential for mass production of doped nanostructures. However, these techniques incur high equipment and processing cost.

*In situ* Fe-doping of ZnO NRs were performed using AA-CVD technique. As the aerosol generator is located outside the reactor, AA-CVD provides the flexibility to control doping parameters such as doping timing, doping duration and a wider choice of dopant precursors. As compared to undoped ZnO NRs, a relative shift of (002) to a lower diffraction angle of Fe-doped ZnO NRs in XRD analysis indicating that Fe<sup>2+</sup> was substituted into the ZnO lattice. The HRTEM image of the Fe-doped ZnO NR reveals a clear lattice spacing of 0.52 nm corresponding to the interplanar spacing of wurtzite ZnO (002) plane. This indicates that the ZnO NRs grew preferentially along the [0001] direction. This result is in good agreement with the XRD analysis. In addition, EDX mapping of Fe-doped ZnO NRs shows that a trace amount of Fe atoms is distributed uniformed on the NRs. The presence of Fe 2p<sub>1/2</sub> and Fe 2p<sub>3/2</sub> peaks at 704.8 eV and 718.4 eV in XPS analysis indicates that the Fe was successfully doped into ZnO NRs as Fe<sup>2+</sup> by *in-situ* doping via AA-CVD. The low I<sub>UV</sub>/I<sub>Vis</sub> ratio of the RTPL spectra indicates that the Fe-doped ZnO NRs have poor crystal quality. The high green emission of Fe-doped ZnO NRs could be attributed by the Fe-induced defects. These defects became the recombination centres, leading to the poor photocatalytic performance in degrading organic dye. However, Fe-doped ZnO nanorods with good UV absorption and weak photocatalytic activities are suitable to be used as UV shield agent such as in the detergent.