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ORIGINAL PAPER: NANO-STRUCTURED MATERIALS (PARTICLES, FIBERS, COLLOIDS, COMPOSITES, ETC.)

Sol–gel grown Fe-doped ZnO nanoparticles: antibacterial and structural behaviors

Nadia Mahmoudi Khatir[1,2] · Zulkurnain Abdul-Malek[1] · Ali Khorsand Zak[3] · Abolghasem Akbari[4] · Farzaneh Sabbagh[5]

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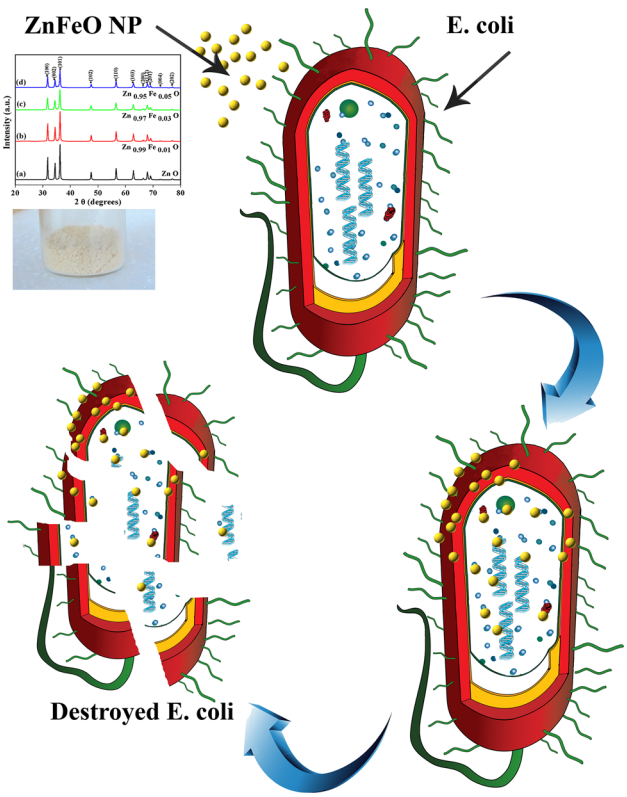
Abstract Bacterial resistance to antibiotic treatment is an attractive issue. The discovery of new antibiotics often does not respond to the rapidly increasing bacterial resistance and needs innovative approaches to combat bacterial infections. The NPs size-dependent strong anti-bactericidal effect of $Zn_{1-x}Fe_xO$ is inspected. Iron (Fe)-doped zinc-oxide (ZnO) nanoparticles (NPs) with composition $Zn_{1-x}Fe_xO$, where $x = 0.0$, 0.01, 0.03, and 0.05 are synthesized by sol–gel method from nitrate precursors and gelatin at fixed calcination temperature of 650 °C maintained for 2 h. The effects of Fe contents on the antibacterial and structural features of these NPs are inspected. XRD patterns display the single-crystalline nature of samples that exist in hexagonal wurtzite phase. SEM images reveal the existence of nearly spherical-shaped single-crystalline NPs. The observed broadening in the X-ray peaks confirms the evolution of crystalline phases in $Zn_{1-x}Fe_xO$ NPs. A quantitative analysis of the size-dependent strain effects is performed through Williamson–Hall and size–strain plot, and its impact of strain on peak broadening is demonstrated. The values of strain, stress, and energy density are calculated. The estimated NPs mean size from FESEM and size–strain plot (SSP) is found to be in close agreement. ZnO NPs in the presence of Fe show some inhibition toward *E. coli* bacterial growth. Fe acting as impurity in the ZnO nanostructure enhances the power oxidation of ZnO resulting in an augmentation of antimicrobial activity.

Graphical abstract



✉ Nadia Mahmoudi Khatir
mahmoudy.phy@gmail.com

1 Faculty of Electrical Engineering, Institute of High Voltage and High Current, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

2 Department of Biotechnology, Faculty of Biological Science, Alzahra University, Tehran, Iran

3 Nanotechnology Laboratory, Esfarayen University of Technology, Esfarayen 96619-98195, North Khorasan, Iran

4 Faculty of Civil Engineering and Earth Resources, University Malaysia Pahang, Lebuhraya Tun Razak, Gambang, 26300 Kuantan, Pahang, Malaysia

5 Faculty of Chemical Engineering, Department of Bioprocess Engineering, Universiti Teknologi Malaysia, 81310 Johor Bahru, Malaysia

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