Optimization of Ca doped in alumina for efficient sunlight-irradiated methylene blue degradation

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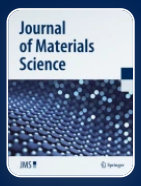

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Abstract

Excessive utilization of synthetic dyes has become a significant environmental concern due to their hazardous effluents. Among various methods, photocatalysis is highlighted as an effective solution. The study involves synthesis, structural and optical characterization of pure and calcium-doped Al_2O_3. The calcium-doped Al_2O_3 nanoparticles reported decreasing trend in the average crystallite size from 6.5 nm to 5.3 nm with high porosity of around 94% for 3% calcium-doped Al_2O_3(3CALO) and specific surface area value of about 1397 m^2/g. The optical band gap of the doped alumina nanoparticles observed a decreasing trend with maximum band gap of 3.57 eV for 3CALO. The presence of metal excess defect is suggested by the band gap as well as the decreasing photoluminescence spectra. The formation of trapping centres and enhanced electron–hole separation is confirmed by the photoluminescence spectra. Even the dye degrading efficiency is observed to be maximum about 80% for 3CALO. The 3CALO nanoparticle is found to exhibit pseudo-first-order kinetic reaction with rate constant maximum about 0.006 min^{-1}, high correlation value of 0.99 and an RSD value of 0.5%. By tailoring the structural and optical properties of alumina through alkaline earth metal doping, it is focussed to develop more efficient, economically feasible,