J Material Sci Eng 2016, 5:3(Suppl)
http://dx.doi.org/10.4172/2169-0022.C1.038

Biomass thermodynamic and ash characterization for assessment of impact on boiler tube corrosion, slagging and fouling

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Ash deposition, slagging and fouling on boiler tube surfaces is an inevitable, though undesirable, consequence of burning coal and biomass in power station boilers. The role of fuel characteristics in affecting the form and severity of the problem is significant. In recent years, biomass fuels have gained increasing popularity as an environmentally friendly source of energy in power plants all over the world. This study is based on experimental corrosion tests under controlled atmospheres and characterising the behaviour of four biomass fuels (pine wood, peanut shells, sunflower stalk and miscanthus) using ash fusion temperature (AFT) tests, simultaneous thermal analysis (STA) of fuel ashes, calculation of empirical indices and predicting ash melting behaviour with the help of thermodynamic equilibrium calculations. Corrosion test results indicated increased metal loss but the AFT results failed to show any clear trend between fusion temperature and high alkali content of biomass. STA proved useful in predicting the different changes occurring in the ash. Empirical indices predicted high slagging and fouling hazards for nearly all the biomass samples and this was supported by the possible existence of a melt phase at low temperatures as predicted by thermodynamic calculations.

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Tuning the electronic band structure of "eco-friendly" ZnS QDs doped with noble metal nanoparticles as superior nanophotocatalyst candidates

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Semiconductor quantum dots are promising candidates for the future optoelectronic applications and energy applications. Doped semiconductors with noble metals such as Au and Ag are called a plasmonic photocatalyst. In this study, eco-friendly well dispersed undoped ZnS quantum dots, QDs, and noble metal doped ZnS QDs (loading amount 4 wt.%) were successfully synthesized on large scale via a green aqueous route at room temperature. The synthesized nanoparticles were characterized via different techniques such as: XRD, XPS, TEM and SEM. The synthesized nanoparticles with its small particle size of 4.5 nm revealed quantum size effect in terms of blue shift in the absorption behaviour with optical band gap, Eg, of 5.06 eV. The photocatalytic activities of bare and doped ZnS QDs were assessed toward the photocatalytic degradation of methylene blue dye. The results revealed a superior photo-efficiency upon doping with noble metal nanoparticles. This superior photocatalytic behaviour of the noble metal doped ZnS QDs photocatalysts could be mainly attributed to Schottky barrier of noble metals which prevents the recombination of the charge carriers and prolongs the lifetime of the photogenerated electrons.

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