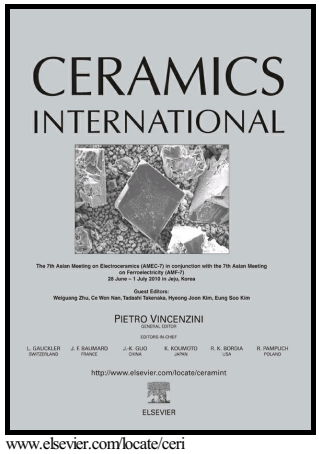

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Surface structural and solar absorptance features of nitrate-based copper-cobalt oxides composite coatings: Experimental studies and molecular dynamic simulation

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Abstract

The copper and cobalt oxides composites coatings on aluminum substrates have been successfully synthesized *via* sol-gel method using nitrate-based sol precursors. The composites were characterized by X-ray Diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Field Emission Scanning Electron Microscopy (FESEM), Atomic Force Microscopy (AFM), and UV-Vis-NIR spectrophotometry. The sol-gel reactions were discussed and Molecular Dynamics (MD) simulation was integrated into the study to predict molecules assembly properties. The XRD analyses revealed that the CuO and the Co_3O_4 composites were formed after the annealing process with the average difference of the calculated lattice parameters compared to ICDDs was 1.17%. The surface electronic structure was mainly consisted of tetrahedral Cu(I), octahedral Cu(II), tetrahedral Co(II), octahedral Co(III) as well as surface, sub-surface and lattice oxygen O^-. The XRD, XPS and MD simulation results showed that there was minimal (or possibly non-existing) indication of copper-cobalt mixed phase oxides formations. FESEM and AFM surveys revealed that the coating had a porous surface composed of interlinked nanoparticles in the range of ~10 to ~40 nm. UV-Vis-NIR reflectance spectra showed that the sol precursors concentration and the dip-drying cycle significantly influenced the absorptance value with optimum absorptance (α) of 88.7% exhibited by coating synthesized using sol concentration of 0.1 M and 10 dip-drying cycles. High absorptance value and simplicity in the synthesis process render the coatings to be very promising candidates for solar selective absorber (SSA) applications.

Keywords

Copper cobalt oxides, nitrate, sol-gel, structural, absorptance, coatings