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Black Cr/ α -Cr₂O₃ Nanoparticles Based Solar Absorbers: Growth Kinetic

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Black chromium-chromium (III) oxide cermet (Ceramic-Metal) nano-composites exhibit attractive solar absorbance characteristics. They are used widely as selective solar heat thermal collector nano-coatings. These black chromium-chromium (III) oxide selective solar absorbers are produced by various physical vapor deposition techniques such as DC and RF reactive sputtering, pulsed sputtering method, and e-beam and thermal evaporation techniques. This contribution reports on large surface coatings of black chromium-chromium (III) oxide cermet by using a novel cost effective physical-chemical method: the Aqueous Chemical Growth (ACG). More specifically, the present study addresses the growth mechanism of the uniform fine (in the range of micron to nano)-spherical particles of α -Cr₂O₃ using the ACG method at low temperature. The growth kinetic of the quasi-mono-dispersed spherical particles of chromium (III) oxide, α -Cr₂O₃, in aqueous solution was studied as a function of ageing time. The small fine spherical particles of α -Cr₂O₃ revealed by SEM micrographs suggests a growth mechanism based on the diffusion-limited Ostwald ripening process on the basis of LSW theory. The experimental data were analyzed in the frame of existing coarsening and particle growth mechanisms, i.e. Ostwald ripening. A good fits of the growth of α -Cr₂O₃ particles with d₃ model confirms the growth mechanism to be mainly diffusion-controlled. Two major configurations have been considered initially: Cr black coated α -Cr₂O₃ nano-particles coatings/Copper substrate and Cr black coated α -Cr₂O₃ nano-particles coatings/discontinuous ultra-thin Cr layer/Copper substrate. The optimized configurations exhibit a low diffuse reflectance as well as low transmittance in the VIS-NIR spectrum sustaining therefore their high solar absorbance property.

Level (Hons, MSc, PhD, other)?

PhD

Consider for a student award (Yes / No)?

Yes

Would you like to submit a short paper for the Conference Proceedings (Yes / No)?

Yes

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