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Voltammetric detection of citric acid using polythiophene/ZnO elctrochemical film

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In the present studies composite films of polythiophene/ZnO (PTh/ZnO) has been prepared on ITO surface. The electrochemical deposition has been carried out using galvanostatic mode in electrolytic cell having single compartment with three electrodes namely ITO, platinum sheet and calomel as working, counter and reference electrode respectively.

ZnO nanoparticles were synthesized by solvothermal method. In a typical procedure KOH solution was added dropwise to zinc acetate dihydrate in methanol solution under stirring. The solution was heated to 60^0C for 1.5 h for precipitation of ZnO nanoparticles. The TEM study revealed that the average particle size is ~6 nm with spherical shape particles. The crystallite size calculated from XRD data is found to be ~6.2 nm with hexagonal wurtzite structure.

The composite film growth was carried out in a solution containing thiophene monomer, tetrabuytlammonium tetrafluoroborate as oxidant and ZnO nanoparticles all present together in nitrobenzene solvent. The shift in FTIR band positions corresponding to PTh indicates the interaction of PTh chain with ZnO nanoparticles. Presence of globulars in SEM image confirms presence of ZnO nanoparticles in the film. Using composite film based working electrode in cyclic voltammogram a redox pair at $E_{1/2}$=-0.68V in citric acid solution in the potential range 0 and -1.2 V at scan rate of 50mVs^{-1} with detection level of 3 mM. Almost linear plot was observed for square root of scan rate versus current density indicating diffusion controlled process. The study shows that the composite film has a potential to act as a taste sensor for citric acid.

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Mathematical models to predict hot working flow stresses and industrial loads of AISI 321 austenitic stainless steel

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In this work, the two hot working constitutive equation models to predict (a) the flow stresses based on Fourier series and (b) to predict the industrial loads are proposed. Results show that there is a good correlation between the predicted (MFS, roll force and the Z parameter) and the actual values from the mill logs. The multipass hot working behavior of stainless steel type AISI 321 was simulated through Gleeble simulated thermomechanical processing where the deformation temperature was varied between 800^0C and 1200^0C and the strain rate was also varied between 0.001/s and 5/s. The effect of hot rolling parameters such as strain, strain rate, and temperature were investigated. It was observed that at strain rates greater than 0.05s^{-1}, dynamic recovery as a restoration mechanism was dominant pushing the dynamic recrystallisation to dynamic recovery transition temperature (DR_{TT}) to higher temperatures. This implied, through extrapolation, that at typical industrial strain rates of about 60s^{-1} no dynamic recrystallization occurs but dynamic recovery. It was also found that when the interpass time (T_{ip})is increased to 20s at a strain rate of 0.01/s , the DR_{TT} was found to be 969^0C and when T_{ip} was reduced to 2s, the DR_{TT} was found to be 959^0C at the same strain rate.

Keywords: Dynamic recrystallization (DRX), Dynamic recovery (DRV), Constitutive equation, Mean flow stress (MFS), Dynamic recrystallization to dynamic recovery transition temperature (DR_{TT}).

Biography

Richard K. C. Nkhoma is a Ph.D. student at the University of Pretoria in the field of Physical Metallurgy. He did his B.Sc. in Malawi and his B.Sc. (Hons) and M.Sc. was done at the University of Pretoria. His background is in mechanical engineering.

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