Investigation Corrosion Fatigue Behaviours of 7075-T6 Aluminum Alloy in Sea Water

A. Khezri*[1] , M. Hajisafari[2]

Abstract

Aluminum alloys due to high strength to weight ratio and good corrosion resistance as compared with other metals, have many applications in sea industries. Most of sea structures are under cycle loadings and these leads to fatigue process. Also, because the structures are in a corrosive environment, sea water, so corrosion process effects on them too and leads to destroy efficiency of the this structures. So investigation of effect of fatigue and corrosion together are an important factor in selecting of an aluminum alloys. In this paper corrosion fatigue behavior of 7075-T6 aluminum alloy was investigated and with obtained results from fatigue test in air was compared. results of the paper shows that a corrosive environment had detrimental effects on the specimen was under cyclic loadings and led to decrease corrosion fatigue life of this alloy in a corrosive environment such as sea water. Corrosive environment lead to form pits on specimens surface and fatigue crack can initiate from the pits and propagate. Fatigue strength of the alloy 33% decreased as compared with specimen in air.

Keywords: 7075-T6 aluminum alloy, fatigue, corrosion fatigue, pitting corrosion.

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Removal Color From Aqueous Solution By Penta Aza Tetra Ethylene Supported On Polyacrylamide As a New Adsorbent Kinetic And Adsorption Isotherm Studies

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Abstract

Modified cross-linked polyacrylamide (PAA) with penta aza tetra ethylene group was used for the removal of Bromocroso green (BCG), industrial dye from aqueous solutions. Batch mode experiments were conducted using various parameters such as pH, contact time, amount of adsorbent and BCG concentration and characterized with FTIR analyses. Fitting the experimental data to different kinetic models including pseudo-first-order, pseudo-second-order, Elovich and intra-particle diffusion kinetic models show the suitability of the pseudo-second-order kinetic model to interpret in the experimental data. The experimental isotherm data were analyzed using Langmuir, Freundlich and Temkin isotherm models. The results showed that the adsorption behavior of BCG on modified adsorbent were well-fitted with the Temkin model at 25˚C. The maximum adsorption capacity was 101.87 mg/g for initial concentration 76 mgL^{-1}.

Keywords: Bromocroso green, Adsorbent, kinetic, isotherm models.

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The effect of nano-alumina addition on the properties of high-alumina low-cement self-flowing refractory castables

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Abstract

In this study, the effect of nano-alumina addition on the properties of high-alumina low-cement self-flowing refractory castables was studied. For this reason, the reactive alumina in the refractory castable composition was substituted by nano-alumina powder. Then, the self-flow characteristics such as; self-flow value and working time of high-alumina low-cement refractory castables were studied. Besides, the physical and mechanical properties, phase composition and microstructure of these refractory castables were studied after drying at 110 °C and firing at 1250 and 1450 °C. The results showed that the nano-alumina addition has a great effect on the self-flow characteristics and mechanical strength of these refractory castables. With addition of nano-alumina particles, the self-flow value and working time tends to decrease due to high surface area of nano-alumina particles. By use of 1 wt.% nano-alumina content in the castable composition, the alumina self-flowing castable with adequate working time can be obtained according to standard values of self-flowing castables. The decrease in porosity and, increase in mechanical strengths after drying is obtained by adding nano-alumina. The phase analysis and microstructure evaluations showed that CA_6 phase can be form at lower temperatures (1250 °C) with the addition of nano-alumina. CA_6 platy formation leads to increase of porosity in the microstructure. But, the because of bonding behavior of platy CA_6, the mechanical strengths are considerably increased after firing.

Keywords: Castable refractory, Hibonite, Low-cement, Nano-alumina, Self-flow.

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Synthesis of nano divalent silver oxide for using in primary zinc-silver oxide battery

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Abstract

In the present study, the effect of particle size of divalent silver oxide has been studied on the electrochemical performance of cathode electrode in the primary zinc-silver oxide battery. Chemical deposition methods were used to produce the powder and the effective parameters in these methods were studied. These include parameters such as concentration, type and order of addition of reactants in the powder production process, addition of surfactant, reaction time and the effect of powder milling by planetary ball mill. X-ray diffraction spectrometer was used to confirm the divalent silver oxide synthesis.The morphology and size of the particles were analysed by scanning electron microscope. The electrodes were prepared by pasting method. Single cells were discharged using constant current of 20 A to evaluate the electrochemical efficiency of produced powders. Single cells contained two zinc electrodes and one silver oxide electrode. Scanning electron microscopy images showed that the morphology of the produced powders was flake type. Particle size reduction below 100 nanometer was performed using surfactant and control of reaction parameters. Results from high-rate discharge tests showed that the capacity and voltage of the optimized electrodes with nano powder were 42% and 0.11 V, respectively, higher than the capacity and voltage electrodes made with the conventional powder.

Keywords:Battery, highrate discharge, synthesis, nano silver oxide.

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Investigation on the effects of the amount and source of carbon on synthesis of Ti2AlC nanostructure by self-propagating high temperature combustion synthesis method

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Abstract

In this study, Ti2AlC ternary carbide by mixing of Ti, Al and C powders and by self-propagating high temperature combustion synthesis method has been synthesized. 2Ti:2Al:1C and 2Ti:2Al:0.5C compounds and carbon sources such as graphite, activated carbon and carbon black were used in order to evaluate the variables of composition and carbon source in the synthesis of Ti2AlC Max phase. First, the primary powders were weighed. Then, the supposed mixed powders were dry grinded for 3 hours. Then, they have been formed in pills under 80 MPa pressure. After applying the self-propagating high temperature combustion synthesis process on the samples, X-ray diffraction analysis and field emission transmission electron microscopy were used to study the phase composition and to observe the microstructure, respectively. Ultimately, determined the maximum amount of synthesized Ti2AlC Max phase was 74 Wt. % and it is related to the sample with 2Ti:2Al:0.5C compound in which the activated carbon is used to provide carbon. Also it was observed that with an increase of 0.5 to 1 mole percent of carbon in the raw materials, weight percent of Ti2AlC MAX phase in the reaction products sharply reduced.

Keywords: MAX phase, Ti_2AlC, Self-propagation high-Temperature synthesis (SHS), carbon source.

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Biosynthesis of silver nanopowders and evaluation on their application in cosmetic products

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Abstract

The use of plant extract in the phytosynthesis of nanoparticles can be an eco-friendly approach and have been suggested as possible alternative to conventional method namely physical and chemical procedure. In the present research, all the chemical reagents were of analytical grade and used without further purification in these experiments. A conventional heating phytosynthesis route by using Fumaria Officinalis was used to produce the Ag nanoparticles. The radical scavenging activity test was used to check their anti-oxidant activities using 2,2-diphenyl-1-picrylhydrazyl (DPPH). The morphological properties and particle size of synthesized Ag nanoparticles have been confirmed by Scanning Electron Microscope (SEM-EDX), Fourier transform Infrared (FT-IR) and Dynamic Light Scattering (DLS). The synthesized nanoparticles were characterized by XRD for the crystallinity, phase purity and average particle crystallites size. Based on FT IR results the OH groups are responsible for reducing and capping of Ag cations. The increase in the intensity of carbonyl group confirms this issue. Moreover, the synthesized nanoparticles possess a range of diameter between 30-40 nm according to the results of SEM. Antibacterial activity against L.monocylogenes, L.monocytogens and E.coil were investigated. Eventually, a cream containing as-synthesized Ag nanoparticles was produced using Rosa cannina extract through a green method. The data from the present research show that stable and spherical Ag nanoparticles were produced using different concentration of Rosa cannina extract which used as precursor. The findings proved that biosynthesis could produce natural cosmetic products like cream as a bio-friendly and cheap method.

Keywords: Rosa cannina; Ag nanoparticles; Cosmetics.

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Investigating the effect of particle size on Volume-per-atom parameter of TiO2 nanoparticles

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Abstract

Nanoparticles are considered as one of the most important building blocks of nanotechnology. Due to the high surface to bulk ratio of nanoparticles, most of their properties and parameters differ significantly from their bulk counter parts. One of these parameters is volume of nanoparticle. In the present work, molecular dynamics (MD) simulation was used to explore the effect of amorphous surface layer on volume-per-atom (Ω) of TiO_2 nanoparticles. Two most common phases of TiO_2, rutile and anatase, were investigated. A novel method was proposed for studying the radial variation of Ω from the center to the surface of nanopaticles. It was found that for atoms located in the crystalline core of TiO_2 nanoparticles, the value of Ω is radial independent and is the same as that of bulk TiO_2. However, in the amorphous surface layer, Ω showed radial variation, with its average value larger than that of crystalline core. Moreover, it was observed that the average volume-per-atom (Ω_{ave}) of TiO_2 nanoparticles is larger that that of bulk TiO_2. For a more detailed examination, the radial variation of coordination number (CN) of titanium ion, from the center to the surface of nanoparticle, was calculated. It was concluded that the lower CN of titanium ions located in the amorphous surface layer, than that of conventional value, i.e. 6, is responsible for larger Ω_{ave} of TiO_2 nanoparticles.

Keywords: TiO_2 nanoparticle; Molecular dynamics simulation; Volume-per-atom.

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The effects of TiO2 nanoparticles on physical and thermal properties of polyurethane foam and sandwich panel

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Abstract

flexible polyurethane foam (PU) and monolithic polyurethane sandwich panel samples reinforced with different weight percent of TiO_2 nanoparticles (0.25, 0.5, 0.75, 1, 1.5 and 2) have been successfully prepared. The effects of TiO_2 nanoparticles on the physical and thermal properties of mentioned samples were examined. In order to observe morphological structure of polyurethane (PU) samples, scanning electron microscopy (SEM) were used. Research results showed that by increasing TiO_2 nanoparticles to 2 wt.%, the density of foam and sandwich panel increased to 32.2% and 62.6%, respectively in comparison with pure sample and amount of water absorption decreased to 45% and 58.8%, respectively. The results of UV analysis showed that the maximum amount of UV rays absorption in PU foam reinforced with 2 wt.% of TiO_2 nanoparticles equals to 3.21 at wavelength of 450 nm. Investigation results of TGA analysis showed that the presence of TiO_2 nanoparticles caused improvement thermal stability of PU nanocomposites. By increasing TiO_2 nanoparticles to 1 and 2 wt.%, the degradation temperature at weight loss equals to 10 wt.% of PU increased 14.5 ºC in comparison with pure sample. Also the degradation temperature of weight loss equals to 50 wt.% of samples reinforced with 1 and 2 wt.% of TiO_2 nanoparticles increased 1 and 3 ºC, respectively.

Keywords: PU, foam and sandwich panel, TiO_2 nanoparticles, physical properties, thermal properties.

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Evaluation of anti-corrosion properties of MIO pigments in the formulation of synthetic rubber based primer used in gas pipeline

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Abstract

In this research, Micaceous Iron Oxide pigments in different ratios were added to a synthetic rubber primer. Coatings were applied on carbon steel (St 37) plates and 8 inch pipe samples. Corrosion behavior of the primers was investigated by use of Electrochemical Impedance Spectroscopy. In addition, in order to investigate the effects of Micaceous Iron Oxide pigments on the adhesion of the primer to steel substrate, cross-cut test has been corried out on carbon steel substrate. Also the adhesion of synthetic rubber tape to the primer has been investigated by peel adhesion through hanging mass method test on pipeline. Scanning electron microscopy was used to investigate dispersion condition of Micaceous Iron Oxide particles in the binder. The Electrochemical Impedance Spectroscopy results indicated that the BRP 5, (containing 5% wt. of Micaceous Iron Oxide particles) BRP 10 and BRP 15 sample has better performance than neat primer. BRP 10 sample has the best barrier effect on corrosion performance. Results of Peel adhesion test indicate that adhesion to cold applied tape for BRP 10 sample has better than neat primer.

Keywords: Pipeline coating, Synthetic rubber primer, Micaceous iron oxide, EIS, Adhesion**.**

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Chemical reduction synthesis of copper nanoparticles in aqueous media in present of maleic acid and polyvinylpyrrolidone (PVP)

F. Ebrahimzadeh [*1]

Abstract

The present investigation reports, novel synthesis of copper nanoparticles with controlled size and shape in an aqueous medium via chemical reduction. These syntheses accomplished using hydrazin hydrate as a reducing agent, cis-butenedioic acid or Maleic acid as the surfactant and polyvinylpyrrolidone (PVP) as a capping agent. The input of extra inert gases was not necessary and this method is very simple and green. Some reaction parameters, such as amount of reactants or surfactant, pH, reaction time or rate and amount of reduction reagent, were effective character for control in the size and shape of the nanoparticles. By the analysis of UV–Vis absorption spectrum, X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS) and energy-dispersive X-ray spectroscopy (EDX), the resultant particles were confirmed to be pure Cu with a face-centered cubic (FCC) structure. Particle morphology was characterized using Fuel emission electron microscopy (FESEM) and transmission electron microscopy (TEM). The synthesis method reported in this work might be helpful for the large-scale production of Cu nanoparticles.

Keywords: copper nanoparticles, hydrazine hydrate, cis-butenedioic acid, polyvinylpyrrolidone (PVP), chemical reduction, aqueous media.

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Achieving optimal conditions for manufacturing of A356 aluminum alloy/ $BN_{(h)}$ composite using stir casting

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Abstract

In the present investigation, a A356 aluminum alloy based composite has been produced by the addition of boron nitride powder with three different conditions including raw powders, coated powder using Ni-P electroless bath and coated aluminum particles with Ni-P/ $BN_{(h)}$ surface composite. Moreover, parameters such as impeller shape and rotation speed have been examined in order to obtain optimized conditions. The results based on scanning electron microscope (SEM) and energy dispersive spectroscopy (EDS) showed that the pre-treatment has a main role in deposition of Ni-P on the surface of BN(h) powders. Also, it was obtained that optimum pretreatment consisting of oxidation in 200 ºC for 1 hr, sensitization in 10g/l $SnCl_2$+30ml/l HCl solution for 15 minutes and then activation in 0.25 g/l $PdCl_2$ +30ml/l HCl solution. Moreover, results showed that the optimum value of added powders was 6% after coating on aluminum particles using the Ni-P electroless bath. Furthermore, the agitator of four-blade type with a radial flow was a good choice for the manufacture of aluminum/boron nitride composite. Also, it was shown that tensile strength of composite materials is not proportional with hardness, so that the tensile strength can decrease while hardness increases.

Keywords: Composite, Boron Nitride, A356 Al alloy, Ni-P electroless, mechanical properties, stir casting.

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An investigation on the effects of interpass temperature on corrosion behavior of weld metal of Hadfield high carbon steel weld joint

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Abstract

In this study, the effects of welding process interpass temperatures on the weld metal corrosion behavior of Hadfield high carbon steel welding joints was investigated. For this purpose, initially 6 austenitized sheets with 2mm thickness prepared from Hadfield steel. Then shielded metal arc welding process with interpass temperature of 700, 850 and 1000°C was used for welding. Then potentiodynamic polarization and electrochemical impedance spectroscopy methods were used to evaluate corrosion behavior of welded joints' weld metal in the 3.5wt. %NaCl solution. Also, the evaluation of the microstructures of weld metal in welded joints were conducted by optical microscopy. X-ray diffraction was used for the analysis of phases formed in the weld metal microstructure and the weld metal corrosion mechanism was determined by scanning electron microscopy examination. Optical microscopy observations and patterns obtained from X-ray diffraction showed that increasing in interpass temperature resulted in increase in carbide precipitates and decrease in austenite grain size in the weld metal microstructures of Hadfield steel welding joints. Corrosion test results showed that by increasing the interpass temperature in the welding process, weld metal of Hadfield steel welding joints showed decreese in corrosion resistance. Also, scanning electron microscopy images from corrosion morphology of weld metals indicated that increasing in interpass temperature in the welding process of Hadfield steel, led to occurrence of micro-galvanic localized corrosion.

Keywords: Hadfield steel, weld metal, corrosion behavior, interpass temperature, welding process.

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