DEFINITION OF THE ROLE OF POLYVINYL ALCOHOL DURING FORMATION AND IN THE STRUCTURE OF CATHODIC SYNTHESIZED COMPOSITE ELECTROCHROMIC NICKEL HYDROXIDE LAYER: TEMPLATE OR SURFACTANT (p. 6–14)

Abstract and References. Materials science

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One of the promising applications of nickel hydroxide is electrochemical electrochromic devices. To significantly improve the characteristics, the role of polyvinyl alcohol (PVA) in the synthesis and structure of composite Ni(OH)\textsubscript{2}-PVA films was investigated by studying the effect of its concentration (30, 40, 50 g/l) and polymerization degree (17-99, 24-99, 30-99 types). Adhesion was investigated visually, and electrochemical and electrochromic properties – by cyclic voltammetry with simultaneous recording of optical characteristics. It was shown that at a concentration of 30 g/l, the film peeled off and had weak electrochemical and electrochromic properties. The presence of two cathodic peaks (E=500–510 mV and E=560 mV) on the cyclic voltammetry showed the presence of nickel hydroxide in the PVA matrix and nickel hydroxide with adsorbed PVA. This indicates the dual role of PVA as a surfactant and as a template. At low concentrations, the role of PVA as a surfactant prevailed. Increasing the concentration led to an increase in the film characteristics by strengthening the role of PVA as a template; at 50 g/l, the film did not peel off and had good electrochemical and electrochromic characteristics.

It is shown that at a low degree of polymerization, PVA (17-99 type) mainly played the role of a surfactant but was also a template. The film cracked and had mediocre characteristics. The use of medium polymerization PVA (24-99 type) gave a film with high adhesion, electrochemical and electrochromic characteristics. It is shown that in this case, PVA performed the function of a template, there was only one cathodic peak on the voltammogram at E=500–510 mV. It was found that the use of PVA with a high degree of polymerization (30-99 type) led to a significant deterioration of the characteristics, including complete peeling of the film. This is probably due to the loss of PVA in the film.

Keywords: nickel hydroxide, electrochromic film, polyvinyl alcohol, template, surfactant, degree of polymerization.

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SYNTHESIS OF TITANIUM DIOXIDE NANOTUBE DERIVED FROM ILMENITE MINERAL THROUGH POST-HYDROTHERMAL TREATMENT AND ITS PHOTOCATALYTIC PERFORMANCE (p. 15–29)

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Ilmenite (FeTiO3) is a suitable mineral to produce titanium dioxide (TiO2) for photocatalyst applications. Therefore, this research was conducted to synthesize TiO2 material from titanium oxysulfate (TiOSO4) extracted from Indonesia local ilmenite mineral (FeTiO3) and to modify this material into TiO2 nanotubes through a hydrothermal process at 150 °C for 24 hours followed by a post-hydrothermal treatment with temperature variations of 80, 100, 120, and 150 °C for 12 hours. The purpose was to investigate the effect of the post-hydrothermal variations on the crystal structure, morphology, and optical properties of the TiO2 nanotubes produced. It was discovered from the scanning electron microscopy (SEM) observations that the TiO2 nanotube was successfully derived from the ilmenite precursor. Moreover, the X-Ray diffraction (XRD) analysis
of the nanotube crystal structure showed that post-hydrothermal treatment enhanced the crystallinity of the anatase TiO$_2$ phase even though the sodium titanate phase was observed to exist in the structure. The increase in the post-hydrothermal temperature from 80 to 150°C was also discovered to have led to:

1) a reduction in the unit cell volume from 136.37 to 132.31 Å$^3$
2) a decrease in the lattice constant c from 9.519 to 9.426 Å;
3) a decrease in the bandgap energy ($E_g$) from 3.33 to 3.02 eV.

These characteristics further indicate the ability of the photocatalytic performance of the nanotubes to enhance the degradation efficiency from 87.69 to 97.11 %. This means the TiO$_2$ nanotubes extracted from local FeTiO$_3$ can provide the expected crystal structure and photocatalytic performance.

**Keywords:** TiO$_2$ nanotube, post-hydrothermal, crystallite size, bandgap energy, photocatalytic, ilmenite mineral.

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IMPROVING THE PROPERTY OF WEAR RATE AND HARDNESS BY ADDING HYBRID NANOMATERIALS TO AA7075 (p. 30–36)

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Aluminum alloys have become an essential material in many modern applications, such as automobiles, marines and aviation industries. It is expected that more applications will heavily depend on aluminum alloys to reduce the weight and maintain safety standards, many previous studies have done in this regard. Numerous of these applications’ parts could be subjected to different loading and environmental conditions. This includes wearing stress and loss of the surface properties. To address these issues, intensive researches have been conducted aiming to improve aluminum wear resistance. However, there is an increasing demand to provide a comprehensive understanding of the mechanisms of enhancing wear resistance. Preparation of nano-materials combined with aluminum alloy can be made in several known metallurgical methods. One of the most important difficulties and challenges faced in the manufacture of these nano-materials is to obtain a homogeneous mixture that does not have manufacturing defects. The present work aims to process and evaluate the Nano-hybrid composites of with different ratio of (Cu+Ti) mixed with AA7075 by using the liquid stir casting method by using (pin-on-disc) wear testing apparatus.

The results showed when using multiple speeds and different loads in practical experiments, that the volumetric wear loss increase from 2.8 mm3 to 29.89 mm3 for zero–Nano and from 0.889 mm3 to 3.09 mm3 for 0.8 % +0.3 % (Cu+Ti) composite at speed 100 to 300 respectively. And from 12.81 mm3 to 0.89 mm3 at 25N. The coefficient of friction is reduced with the addition of reinforced material at 0.8 % +0.3 % (Cu+Ti) composite from 0.172 to 0.05. The hardness (BH) of the prepared composites increases with increasing the amount of hybrid Nano–reinforced materials. The enhancement percentage of 25.4 % to 39.5 % from 0.889 to 3.09 mm3 for zero-Nano and from 0.889 to 3.09 mm3 for 0.8 % +0.3 % (Cu+Ti) composite at different loads in practical experiments.

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Keywords: AA7075, nano-hybrid material, wear rate, coefficient of friction, hardness test.

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Одним із перспективних напрямів використання гідроксиду нікелю є електрохімічні електрохромні пристрої. Для суттєового покращення характеристик було досліджено роль полівінілового спирту (ПВС) при синтезі та у структурі композитних плівок Ni(OH)2-ПВС шляхом вивчення впливу його концентрації (30, 40, 50 г/л) та ступеню полімеризації (типи 17-99, 24-99, 30-99). Ад- десія досліджувалася візуально, електрохімічними та електрохромними властивостями – методом циклічної вольтамперометрії із одночасною фіксацією оптичних характеристик. Показано, що при концентрації 30 г/л плівка відшаровується та має слабкі електрохімічні та електрохромні властивості. На навантаженнях двох катодних піків (E = 500–510 мВ і E = 560 мВ) на циклічній вольтамперограмі показує навіяння гідроксиду нікелю в матриці ПВС та гідроксиду нікелю з адсорбованим ПВС. Це вказує на поєднану роль ПВС – як ПАР та як темплат. При низьких концентраціях роль ПВС як ПАР превалює. Підвищення концентрації призводить до збільшення характеристик плівки за рахунок підсилення ролі ПВС як темплат: при 50 г/л плівка не відшаровується та має добри електрохромні та електрохромні характеристики. Показано, що при низькому ступене полімеризації ПВС (тип 17-99) переважно гріє роль ПАР, однак також є темплат. Плівка при цьому розширюється та має посередні характеристики. Використання ПВС середнього ступеня полімеризації (тип 24-99) дозволяє отримати плівку з високими адгезійними, електрохромними та електрохромними характеристиками. Показано, що в цьому випадку ПВС виконує функцію темплату, на циклічній вольтамперограмі є тільки один катодний пік при E = 500–510 мВ. Виявлено, що використання ПВС з високим ступенем полімеризації (тип 30-99) призводить до суттєвого погіршення характеристик, в тому числі до повного відшарування плівки. Імовірно, це пов’язано із збитковою кількістю ПВС в плівці.

Ключові слова: гідроксид нікелю, електрохромна плівка, полівініловий спирт, темплат, ПАР, ступінь полімеризації.

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Я́мейн (FeTiO3) є підходящим матеріалом для отримання діоксиду титану (TiO2) для фотоактівізаторів. Тому дане дослідження було здійснено для вивчення електрохемічних властивостей синтезованої плівки FeTiO3 шляхом вивчення впливу її концентрації (30–99) і ступеню полімеризації (тип 17–99). Використаний метод циклічної вольтамперометрії (CV) показує на амперетрафії пік при E = 0,2–0,4 В. Електрохромні характеристики — волтамперограма з двома катодними піками при E = 0,2–0,4 В.

Ключові слова: напір, діоксид титану, мінеральна сировинна, вольтамперограма

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Алюмінієві сплави стали незамінним матеріалом у багатьох сучасних галузях, таких як автомобілі, суднобудування та авіація. Очікується, що більша кількість додатків значною мірою залежить від алюмінієвих сплавів для зниження ваги та дотримання стандартів безпеки, у цьому відношення було проведено безліч попередніх досліджень. Деталі багатьох з цих
Додатків можуть зазнавати різних навантажень та умов навколишнього середовища. Це включає навантаження на зношування та втрату властивостей поверхні. Для вирішення цих проблем було проведено інтенсивні дослідження, спрямовані на підвищення зносостійкості алюмінію. Проте зростає потреба у забезпеченні всебічного розуміння механізмів підвищення зносостійкості. Одержання наноматеріалів у поєднанні з алюмінієвим сплавом може здійснюватись кількома відомими металургійними методами. Однак з найважливіших труднощів та завдань, що виникають при виготовленні цих наноматеріалів, є отримання однорідної суміші, яка не має виробничих дефектів. Наведена робота спрямована на обробку та оцінку наногібридних композитів з різними співвідношеннями (Cu+Ti), смиканих з AA7075, з використанням методу лиття з перемішуванням рідини з використанням пристрою для випробувань на знос (штифт на диску). Результати показали, що при використанні кількох швидкостей та різних навантажень у практичних експериментах об'ємні втрати на знос збільшуються з 2,8 мм³ до 29,89 мм³ для нуль-нано та з 0,889 мм³ до 3,09 мм³ для 0,8 %+0,3 % (Cu+Ti) композиту за швидкості від 100 до 300 відповідно. Коефіцієнт тертя знижується при додаванні армуючого матеріалу 0,8 %+0,3 % (Cu+Ti) композиту з 0,172 до 0,05. Твердість (ВН) отриманих композитів збільшується з 12,81 до 25Н. Коефіцієнт тертя знижується при додаванні наногофелюваного гібридного матеріалу 0,8 %+0,3 % (Cu+Ti) композиту з 0,172 до 0,05. Твердість (ВН) отриманих композитів збільшується зі збільшенням кількості наногібридних матеріалів. Досліджувані впливи покращення 25,4 % порівняно з матричним матеріалом. Ці добавки у певних пропорціях покращували механічні властивості.

Ключові слова: AA7075, наногібридний матеріал, швидкість зношування, коефіцієнт тертя, випробування на твердість.