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USAGE OF ACRYLIC ACID BASED POLYMER FOR STABILIZATION OF NICKELINE NANOPARTICLES

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ABSTRACT

In this work, our team synthesized polyacrylic acid-supported Ni nanoparticles and SEM images were shown of polyacrylic acid-supported Ni nanoparticle samples at different magnifications in low electron mode at different voltages. The study examined the solubility of nickel nanoparticles depending on their concentration, and also studied the influence of the activity of acidity and basicity of the medium and the concentration of nanoparticles on the overall distribution of the suspension. We have obtained nanoparticles of metallic nickel. To study the effect of an acidic environment on the dispersion of suspensions of nickel nanoparticles, various solutions with different alkalinity and acidity were created. Consequently, it was observed that the acidity level of the medium has minimal influence on the average particle size within suspensions of identical concentrations. The size of nickel nanoparticles remains highly diminutive and can be readily tailored by adjusting both the polymer type and concentration in each specific context. At selected polymer concentrations that provide the same number of monofragments, PAA is the best stabilizer.

Keywords: PAA, solution, suspension, nanoparticles, TEM.

Introduction

Nickel salt reduction with sodium borohydride and a polymer coating, particularly polyacrylic acid (PAA), yields ample quantities of uniform and electrochemically active nickel nanoparticles. Analysis through techniques like transmission electron microscopy, powder X-ray diffraction, Fourier transform infrared spectroscopy, and cyclic voltametry confirms their monodisperse nature. The small size of these nanostructured nickel particles can be altered by selecting different polymers, offering a means to tailor their properties. The synthesized nickel and its amount were determined from the experimental data of the experimental equipment of the experiments. Nickel composites were prepared using ultra sanitary and centrifugation.

When borate is used, solutions change color depending on the polymer material.

Extensive exploration into nanomaterials has been driven by their immense scientific and technological promise, seeking to unveil novel functional materials distinguished by their exceptional properties and utility. Recently, nickel nanoparticles have emerged as versatile components with applications spanning chemical catalysis, electrocatalysis, conductive dyes, magnetic materials, rechargeable batteries, medical diagnostics, superconducting devices, and

beyond. The broad spectrum of potential uses makes nickel a captivating metal nanomaterial for researchers exploring diverse fields [1-3].

Producing nanostructured nickel materials poses a challenge among magnetic metal nanomaterials due to their susceptibility to oxidation. However, over recent decades, various chemical and physical methods have been devised to surmount this obstacle and generate high-quality nickel nanoparticles.

Different synthetic methods have been developed, providing versatile and precise techniques to regulate parameters like particle size, shape, crystal phase, and other pertinent attributes..

In summary, nanocrystals are highly prized for their advantageous properties and the cost-effectiveness of the manufacturing process. Nevertheless, polymers have been widely employed in chemical methods to inhibit nanoparticle aggregation and shield them from oxidation. More specifically, polymers act as stabilizers for metal nanoparticles through structural hindrance, and they also weakly bind to the nanoparticle surface using heteroatoms as ligands.

Polymer-stabilized metal nanoparticles exhibit the ability to uniformly disperse in both organic solvents and water, facilitating their integration with reactants and products akin to homogeneous catalytic systems. As demonstrated in this study, polyacrylic acid served as a stabilizing agent for such nanoparticles [5-7].

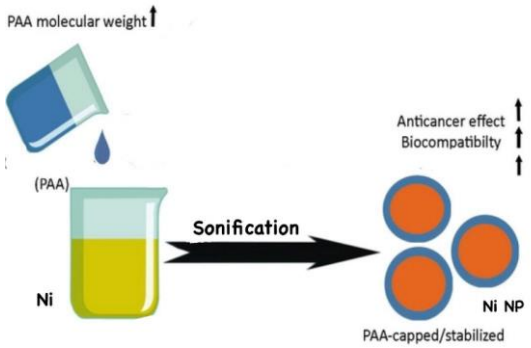
The acrylic acid procured from Merck company in Darmstadt, Germany, underwent purification through vacuum distillation.

To synthesize polyacrylic acid in an aqueous solution, the materials used comprised 8.4 grams of acrylic acid, 0.3 milliliters of 30% hydrogen peroxide, and 28 milliliters of distilled water.

Materıals and methods

Synthesis of polyacrylic acid (PAA).

To synthesize polyacrylic acid (PAA), a solution of hydrogen peroxide and acrylic acid was prepared in distilled water. Subsequently, the solution was transferred into a clean, dry ampoule made of semi-permanent refractory glass at the midway point of the process. The narrow end of the ampoule was sealed and then placed in an oven at 100 degrees Celsius for 11 days to initiate polymerization. After this period, the bulb was cooled and cautiously opened. The resulting thick liquid represented a solution of polyacrylic acid in water, which could be obtained by evaporating the water under vacuum conditions. Nickel nanoparticles with polymer protection were synthesized. First, NiCl2 was mixed thoroughly with a temporary mixture of 40 ml water. Then, solid NaBH4 (0.2 g, 5.29 mmol) was added and mixed continuously. One minute after adding NaBH4, 2 mol of NaOH was promptly dissolved in 50 mL of water.



To prepare nickel nanoparticles with PAA protection, the process included dissolving PAA by gently stirring it in approximately 20 mL of water. Next, NiCl2, 6H2O was added to the mixture, followed by thorough mixing, after which solid NaBH4 was added.

Characterızatıon Of Nanostructure

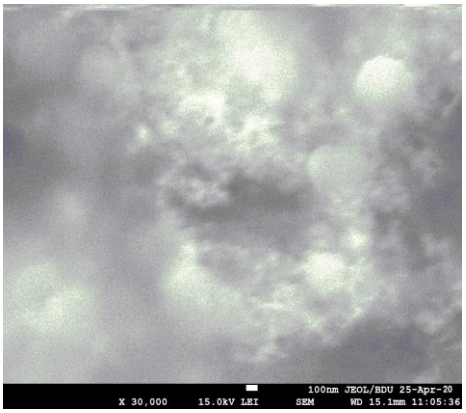


Fig.1. TEM drawings of samples of nanoparticles synthesized by us in laboratory conditions are presented: nickel nanoparticles, (12000) (15 keV).

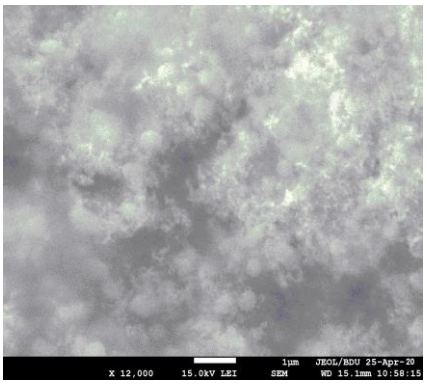


Fig.2. TEM drawings of samples of nanoparticles synthesized by us in laboratory conditions are presented: nickel nanoparticles, (15000) (15 keV).

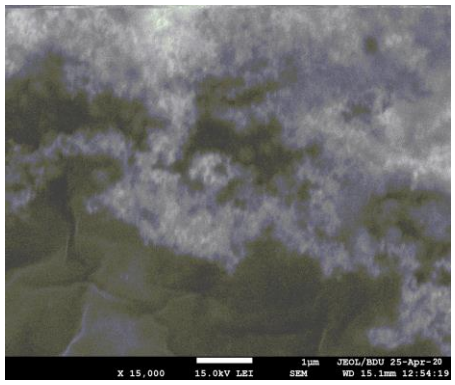


Fig.3. TEM drawings of samples of nanoparticles synthesized by us in laboratory conditions are presented: nickel nanoparticles, (30000) (15 keV).

The dıscussıon of the results

Simple reduction of nickel salt with sodium borohydride results in ample production of monodisperse and electrochemically active nickel nanoparticles when employing a polymer coating, specifically polyacrylic acid (PAA). The characterized nanoparticles underwent analysis through transmission electron microscopy, powder X-ray diffraction, Fourier transform infrared spectroscopy, and cyclic voltameter. The size of the nanostructured nickel is minimal, and altering the polymer allows for modification of properties.

The synthesized nickel and its amount were determined from the experimental data of the experimental equipment of the experiments. Nickel composites were prepared using ultra sanitary and centrifugation.

When borate is used, solutions change color depending on the polymer material.

Conclusıon

Nanoparticles of metallic nickel were acquired for examination. To assess the impact of an acidic environment on the dispersion of nickel nanoparticle suspensions, various solutions with differing alkalinity and acidity were prepared. It was observed that the acidity of the medium minimally affects the average particle size for suspensions of the same concentration. The small size of the Ni nanoparticles allows for easy adjustment by altering the polymer and concentration in each scenario. Among selected polymer concentrations providing an equal quantity of mono fragments, polyacrylic acid (PAA) emerged as the optimal stabilizer.

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ИСПОЛЬЗОВАНИЕ ПОЛИМЕРА НА ОСНОВЕ АКРИЛОВОЙ КИСЛОТЫ ДЛЯ СТАБИЛИЗАЦИИ НАНОЧАСТИЦ НИКЕЛЯ

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РЕЗЮМЕ

В этой работе наша команда синтезировала наночастицы Ni, нанесенные на полиакриловую кислоту, и были показаны СЭМ-изображения образцов наночастиц Ni, нанесенных на полиакриловую кислоту, при разных увеличениях в низкоэлектронном режиме и при разных напряжениях. В ходе исследования изучена растворимость наночастиц никеля в зависимости от их концентрации, а также изучено влияние активности кислотности и основности среды и концентрации наночастиц на общее распределение суспензии. Мы получили наночастицы металлического никеля. Для изучения влияния кислой среды на дисперсность суспензий наночастиц никеля были созданы различные растворы с различной щелочностью и кислотностью. Следовательно, было замечено, что уровень кислотности среды оказывает минимальное влияние на средний размер частиц в суспензиях одинаковых концентраций. Размер наночастиц никеля остается очень маленьким, и его можно легко адаптировать, регулируя тип и концентрацию полимера в каждом конкретном контексте. При выбранных концентрациях полимера, обеспечивающих одинаковое количество монофрагментов, ПАК является лучшим стабилизатором.

Ключевые слова: ПАК, раствор, суспензия, наночастицы, ПЭМ.

AKRİL TURŞUSU ƏSASLI POLİMERİN NİKEL NANOHİSSƏCİKLƏRİNİN STABİLLƏŞDİRİLMƏSİ ÜÇÜN İSTİFADƏSİ

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XÜLASƏ

Bu işdə komandamız poliakrilik turşu üzərinə çökdürülmüş Ni nanohissəciklərini sintez etdi və müxtəlif gərginliklərdə aşağı elektron rejimində müxtəlif böyütmələrdə poliakrilik turşu üzərinə çökdürülmüş Ni nanohissəcik nümunələrinin SEM şəkilləri göstərildi. Tədqiqat zamanı nikel nanohissəciklərinin konsentrasiyasından asılı olaraq həllolma qabiliyyəti araşdırılmış, həmçinin mühitin turşuluq və əsaslıq aktivliyinin və nanohissəciklərin konsentrasiyasının suspenziyanın ümumi paylanmasına təsiri öyrənilmişdir. Biz metal nikelin nanohissəciklərini əldə etdik. Turşu mühitin nikel nanohissəciklərinin suspenziyalarının dispersiliyinə təsirini öyrənmək üçün müxtəlif qələvilik və turşuluqlu müxtəlif məhlullar hazırlanmışdır. Nəticə etibarilə, eyni konsentrasiyalı süspansiyalarda mühitin turşuluq səviyyəsinin orta hissəcik ölçüsünə minimal təsir göstərdiyi müşahidə edilmişdir. Nikel nanohissəciklərinin ölçüsü olduqca kiçik olaraq qalır və hər bir xüsusi kontekstdə həm polimer növünü, həm də konsentrasiyanı tənzimləməklə asanlıqla uyğunlaşdırıla bilər. Eyni sayda monofraqmentləri təmin edən seçilmiş polimer konsentrasiyalarında PAA ən yaxşı stabilizatordur.

Açar sözlər: PAA, məhlul, suspenziya, nanohissəciklər, TEM.