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In volume six issue eighteen as the first article we present, *Failure of an autotank repaired by welding*, by SALGADO-LOPEZ, Juan Manuel, OJEDA-ELIZARRARÁS, José Luis, SILVA-HERNANDEZ, Abraham and TELLO-RICO, Jesús Mauricio, as a second article we present, *Neurotoxic effect of non-functionalized carbon nanospheres*, by KASHINA, Svetlana, FLORES-VILLAVICENCIO, Lerida Liss, JACOBO-AZUARA, Araceli and GALINDO, Rosario, with an appointment at Universidad de Guanajuato, as a third article we present, *Classification of emotions from the recognition of facial expressions applied to the prevention of secondary Alexithymia: an analysis of the state of the art*, by PADILLA-NAVARRO, Christian, ZARATE-TREJO, Carlos, KHALAF, Georges and FALLAVOLLITA, Pascal, with secondment at the Universidad Autónoma de Nayarit, as fourth article we present, *Development of a coating with UV protection for leather finishing in the automobile industry*, by AGUILAR-MARURI, Saul, VALENCIA-RODRÍGUEZ, Samantha, GALINDO-GONZÁLEZ, Rosario and FUENTES-RAMÍREZ, Rosalba, with secondment Universidad de Guanajuato.
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Failure of an autotank repaired by welding

Fallas de soldadura de reparación de autotanque

SALGADO-LOPEZ, Juan Manuel†*, OJEDA-ELIZARRARÁS, José Luis, SILVA-HERNANDEZ, Abraham and TELLO-RICO, Jesús Mauricio

ID 1st Author: Juan Manuel, Salgado-Lopez / ORCID: 0000-0002-2384-1887, CVU CONACYT ID: 94744
ID 1st Coauthor: José Luis, Ojeda-Elizarrarás / ORCID: 0000-0001-8412-7778, CVU CONACYT ID: 81630
ID 2nd Coauthor: Abraham, Silva-Hernandez / ORCID: 0000-0003-2699-8107, CVU CONACYT ID: 726099
ID 3rd Coauthor: Jesús Mauricio, Tello-Rico / ORCID: 0000-0002-5657-2134, CVU CONACYT ID: 586320
DOI: 10.35429/JSTA.2020.17.1.9
Received January 25, 2020; Accepted June 30, 2020

Abstract

The aim of this work is to show that welded vessels, which have been coated by a polymer for overcoming the pneumatic test are susceptible to failure. This is so, because the cyclic load, which are applied in the vessel during its work. This aim was reached by applying different inspections and tests to a vessel manufactured with aluminum plates, which was used to freight. The vessel had to be repaired by welding, but it failed after few cycles of loading/unloading in the repaired weld. The specimen under study was inspected visually and by non-destructive tests. In this sense, the plate with fracture was tested by mechanical stress test, optical emission spectrometry, and metallographic analysis. The fracture surface was inspected by scanning electron microscopy. The results of all the techniques showed that the failure occurred due to coalesce of multiple cracks that grew by the mechanism of fatigue from welding defects. On the fracture surfaces was found evidence of sealing polymer used for the pneumatic pressure test. This work demonstrates that in welding repairing, the metallurgy and the welding engineering are critical to avoid premature failures of welded components.

Welding, Aluminum, Failure, Fatigue

Resumen

El objetivo de este trabajo es dejar en claro que recipientes soldados que han sido recubiertos por un polímero para superar la prueba neumática de presión son susceptibles a fallar cuando son sometidos a cargas cíclicas durante el trabajo. Esto se logró aplicando diferentes inspecciones y ensayos a un autotanque fabricado de placas de aluminio que requirió ser reparado por soldadura y falló en la soldadura de reparación después de algunos ciclos. En el espécmien bajo estudio fue inspeccionado en el sitio visualmente y por medio de prueba no destructiva. En este sentido la placa con la fractura fue ensayada por ensayo mecánico de tensión, espectrometría de emisión óptica, y análisis metalográfico. La superficie de fractura fue inspeccionada por microscopía electrónica de barrido. Los resultados de todas las técnicas demostraron que la falla ocurrió por la incidencia de múltiples grietas que crecieron por el mecanismo de fatiga a partir de defectos de soldadura. En las superficies de fractura fueron encontrados rastros de polímero sellador utilizado para la prueba de presión neumática. Este trabajo demuestra que, en soldadura de reparación, el conocimiento en la metalurgia y la ingeniería de soldadura son críticos para evitar fallas prematuras en uniones reparadas por soldadura.

Soldadura, Aluminio, Falla, Fatiga


* Correspondence to Author (Email: mslgado@cidesi.edu.mx)
† Researcher contributing as first author.
Introduction

In the technical literature it has been reported that flaws in welded components play a very important role in their premature failures; since the combination of workloads with stress risers (as flaws are) leads to crack growth by fatigue or failures due to overload [1-2]. Both cases indicate that defects reduce the load area with which the stress is locally increased and it results in a failure [4-8].

In the other hand, it is common practice in the cast aluminum industry to fill with a polymer cast defects such as shrinkages, connected blows, etc. [9-10]. However, sometimes this practice is applied after welding aluminum components [10-11]. In this work it is shown an example of the problems of such practice in welding repair with a case of the failure of the auto tank’s vessel made of aluminum that was repaired in a section (figures 1 and 2).

![Figure 1](image1.jpg) The image shows the failed section of the vessel
Source: own work [PDFcreator]

The failed vessel consisted of rings made of aluminum plates. A repair was done on the body of such component and it consisted of a plate welded to the body as a patch. The auto-tank failure consisted of the separation of the patch plate from one of the sides of the vessel during the filling. It should be noted that the cause of the repair was not the objective of this work, then it was not possible to analyze the previous failure that gave rise to the need for the patch. The failed plate occurred during a polymer loading event and consisted of the detachment of the patch plate, which led to an accident.

![Figure 2](image2.jpg) The image shows the original fracture of the vessel and the fracture of the weld joining the patch. Evidence of the polymer placed on the edge of the patch plate (red spot) was found
Source: own work [Canon powershot A3400IS]

This component worked for five years after the repair and there was no technical information about the repairing such as welding procedure (WPS), cause of the need for repair, periods and type of preventive maintenance, types of non-destructive inspections performed, etc., was obtained. The metallurgical cause of the original fracture of the vessel could not be identified because the evidence was erased during the repairing of it.

Methodology

In order to find the metallurgical reason that led the detachment of the vessel patch, different techniques were applied such as: in situ naked eye visual test. Besides, dye penetrant inspection on the external surface of the vessel was carried out in the location of the failure and the visual inspection in the laboratory using a stereographic microscope.

Mechanical testing of the failed plate was performed following ASTM-E08-16 [12]. Three specimens of the repaired plate were tested using an INSTRON model 4482 universal testing machine. In the case of microhardness profile, measurements of the Vickers microhardness were carried out on a Wilson hardness, Tukon Model 1202 microdurometer.
The metallographic analysis was carried out with samples, which were cut in the transverse plane to the weld. The samples were prepared to observe the microstructure following ASTM-E03-11. The microstructures were revealed by chemical etching with Kellers reagent. The microstructure was observed using an NIKON EPİPHOT 200 optical microscope with image analyzer.

The fractographic analysis was performed in three different areas of the fracture surface using a JEOL JSM 6610LV scanning electron microscope (SEM) with an EDAX probe for EDS microanalysis. Each fracture surface had the following dimensions: 9 mm in width and 250 mm in length. It should be mentioned that the fracture surface samples were cut from the specimen under study by mechanical cutting using coolant.

The results of each technique were analyzed as a whole and from there the metallurgical cause of the failure was found.

Results and discussion

As previously noted, the objective of this work was to determine the metallurgical causes that led to the fracture and detachment of the vessel repair plate and to show that filling with polymer the welding flaws does not avoid failures. In this section there are shown the most important results.

In situ visual test was carried out on the failed vessel and it showed that the failure was a crack that grew following the weld metal of the aluminum plate that served as a patch on the vessel, which was detached during the loading process. Similarly, the visual inspection proved that there was evidence of welding flaws such as aligned porosity, undercuts, lacks of fusion, etc. This fact matches with the evidence that the crack grew following the weld toe, either at the foot of the weld bead or in the middle of the weld metal (Figures 3 and 4). This fact indicates that welding defects played an important role in the failure of the vessel patch plate [12-17].

On the other hand, it should be noted that evidence of resin was found on the welded joints of the vessel. In addition, this evidence of resin was observed throughout the outer and inner surfaces of the weld metal.

No information was found about the non-destructive tests that were carried out after repairing neither the preventive maintenance. This information is important because it gives a technical frame about the defects found in the weldment and if they grew with the loading / unloading cycles of the vessel [17-18].

The visual test in the vessel showed evidence of repairs away the failed patch. The Dye penetrant test that carried out on the external surface of the welding of the vessel indicated that there were flaws such as undercuts (figure 5 and 6) but there was no evidence of crack growth of the defects located on the weld metals of such repairs. This evidence meant that this vessel did not suffer from any excessive pressure. This fact matched with the Dye penetrant test performed on the surface patch in the upper part of the vessel, where no evidence of overpressure damage was found [19].
Failure of an autotank repaired by welding.

The visual testing carried out on the specimens delivered to the laboratory showed that the fracture of the patch plate grew following the weld seam, either at the toe or in some cases in the middle of the deposited metal. These evidences clearly indicated that the fracture of this component was due to flaws in the welded joint. This fact demonstrates the importance of welding procedure specification (WPS) and the manufacturing records, in order to discover possible divergences between the procedure and the actual joint.

Even though the laboratory requested technical information or the evidence of the non-destructive inspections carried out both in the preventive maintenance and after the repair welding process, the vessel’s owner had no information. Therefore, it was not possible to correlate the welding procedure (WPS) to the evidence found in this service.

Visual testing in the laboratory using a stereographic microscope confirmed the existence of defects such as porosity, lack of fusion and incomplete penetrations along the weld seams present in the patch plate of the vessel under analysis (figures 7 and 8). This also applies to welded joints of the internal reinforcements of the patch plate. This evidence is very important because it indicated that the welding process of both welds were performed in not the best way [19].

Another very important evidence was revealed by the inspection using a stereographic microscope. This evidence was fatigue marks in many regions of the weld bead (Figure 9). This fact is important because it confirmed that in the failure of this welded joint occurred by fatigue but several regions with origins of fatigue marks indicated the existence of multiple origins of the fracture. In this way, it was remarkable that all fatigue origins were located in welding defects such as incomplete fusion or aligned porosity [6-7]. These facts were confirmed by the inspection using SEM.
Through the inspection by Scanning Electron Microscopy (SEM) on the fracture surfaces of the fractured specimens the existence of fatigue striations was demonstrated. This fracture pattern proved that the cracks grew due to the fatigue mechanism (Figure 10). However, there was not a single crack origin but several, so it was not possible to determine the origin of the primary crack. This evidence matched with the information about the four year work of this vessel after the repair of the vessel with a patch plate. This working time is reflected in the number of fatigue cycles and the fact that weld metal failed in the last loading event indicated that the final fracture was caused by the classic plastic collapse in fatigue failures.

In this same sense, in the fracture surfaces evidence of polymer was found in the porosity detected (figures 10 and 11), this fact indicated that the fracture surface was in contact with the polymer powders before the final failure of the patch plate occurred. If one takes into account that the polymer was only housed inside the vessel then it is feasible that the crack grew for four years and the weld collapsed in the last material loading event [20-23].

In the case of the Energy Dispersive X-ray Spectroscopy microanalysis (EDS) performed in cross-section sample of the weld metal prepared for metallography. There was found evidence of a trapped inclusions (figure 12), the EDS results indicated that it was aluminum oxide (figure 13), whereby this trapped alumina originated in the preparation of the welded joint. In the literature it has been reported that the most common causes of porosity in aluminum welding are: contamination on the surface to be welded, the poor preparation of the parts to be joined, the inadequate application of protective gas, applying welding dragging to the weld metal, to use a carbon steel bristle brush to clean the surfaces to be welded [3, 6].
Failure of an autotank repaired by welding.

The macrostructural analysis performed on the welded joint probed the existence of welding defects and non-efficient joint design (figure 14). Similarly, it is clear that aligned porosity located on the surface of the weld metal was covered by a polymer layer (Figure 14).

These evidences indicated that the polymer coating (resin) should have been applied as a measure to prevent fluid leakage from inside the vessel, with which the weld inspection accepted the welding.

On the other hand, microstructural analysis showed the existence of dendrites and interdendritic precipitates, in addition to porosity of different dimensions in the microstructure of the weld metal (figure 15).

In the case of the microstructure of the Heat Affected Zone (HAZ), it is seen the existence of metallic precipitates of different types both in the grain boundaries and inside the grains. In fact it can be observed growth precipitates. This type of microstructure is consistent with the welding microstructures of precipitation hardenable aluminum alloys that have been welded (Figure 15).
This matches with the quantitative chemical analysis that showed that the patch plate material is similar to that specified in the standard chemical composition of an AISI 5052 aluminum alloy.

In the case of mechanical properties, the results indicate that according to ASTM B290M this 5062 aluminum alloy the mechanical properties matched with an alloy 5052 in condition H32 that was hardened by rolling and then stabilized by heat treatment from aged to low temperature up to a quarter of hardness. Table 1 shows the average values of the tensile test. Table 2 shows the average microhardness profile measured in the HAZ of the failed specimen. There is seen the variation of microhardness from the weld metal into the base metal.

In this case non relevant information for the fracture of the material was obtained by the mechanical test or the microhardness profile; then no further discussion was done.

### Table 1 Mechanical properties of the base metal [Instron 4482]

Source: prepared by the authors [EXCEL2013]

<table>
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<th>Property</th>
<th>Laboratory results (average)</th>
<th>ASTM B209M-5052 H32</th>
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<tbody>
<tr>
<td>Ultimate tensile strength</td>
<td>225.26 MPa</td>
<td>215-265MPa</td>
</tr>
<tr>
<td>Yield strength</td>
<td>169.62 MPa</td>
<td>163MPa max.</td>
</tr>
<tr>
<td>Elongation</td>
<td>17.35%</td>
<td>7% min.</td>
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</table>

### Table 2 Average Microhardness profile of the HAZ [Model Tukon 1202]

Source: prepared by the authors [Excel 2013]

<table>
<thead>
<tr>
<th>Indentation</th>
<th>Hv in HAZ</th>
<th>Hv</th>
<th>HR15T</th>
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<tr>
<td>1</td>
<td>77.5</td>
<td>71.2</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>67.2</td>
<td>66.6</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>81.1</td>
<td>72.5</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>76.3</td>
<td>70.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>70.2</td>
<td>68.1</td>
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<tr>
<td>6</td>
<td>72.6</td>
<td>69.3</td>
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<td>7</td>
<td>69.8</td>
<td>67.9</td>
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<td>10</td>
<td>70.3</td>
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</tr>
<tr>
<td>Average</td>
<td>72.6</td>
<td>69.1</td>
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### Conclusions

The previously discussed facts lead to the following conclusions:

1. The fracture of the component occurred only in the weld metal that connected the patch plate with the vessel.
2. There were multiple origins of cracks.
3. The cracks grew by fatigue.
4. This mechanism was originated in the flaws of the welded joint.
5. The material was characterized and with it was determined that the material of the vessel patch consists of an AISI 5052 aluminium alloy having an H32 heat treatment.
6. There was found evidence of polymer in the weld metal and in the crack.
7. The polymer applied for filling welding flaws did not increased the fatigue resistance of the welded joint.

### References


Neurotoxic effect of non-functionalized carbon nanospheres

Efecto neurotóxico de las nanoesferas de carbono no funcionalizadas

KASHINA, Svetlana†, FLORES-VILLAVICENCIO, Lerida Liss¨, JACOBO-AZUARA, Araceli´ and GALINDO, Rosario*´

Universidad de Guanajuato, Division of Natural and Exact Sciences, Department of Chemistry.
Universidad de Guanajuato, Division of Natural and Exact Sciences, Department of Biology.
CONACYT Chair at the Universidad de Guanajuato, Division of Natural and Exact Sciences.

ID 1st Author: Svetlana, Kashina / ORC ID: 0000-0003-4277-2060, CVU CONACYT ID: 516653
ID 1st Coauthor: Lerida Liss, Flores-Villavicencio / ORC ID: 0000-0001-6349-6005, CVU CONACYT ID: 38686
ID 2nd Coauthor: Araceli, Jacobo-Azuara / ORC ID: 0000-0003-0967-1858, CVU CONACYT ID: 104385
ID 3rd Coauthor: Rosario, Galindo / ORC ID: 0000-0002-3612-1555, CVU CONACYT ID: 223987

DOI: 10.35429/JSTA.2020.17.6.10.13 Received January 18, 2020; Acceptance June 30, 2020

Abstract

Objective. Different types of nanoparticles, including carbon ones, were tested for a variety of biological applications. Alongside with promising results, some undesired side effects were disclosed. Most biological studies were performed on highly functionalized carbon nanospheres, so the main objective of this study was to assess cytotoxicity of unfunctionalized carbon nanospheres synthesized by sol-gel method. We hypothesize that unfunctionalized material will present different cytotoxic pattern on cell culture. Methodology. 3 carbon nanosphere materials were synthetized by sol-gel method. Particles shape, size and functionalization were assessed. Cytotoxic effect of synthesized materials was evaluated on SH-SY5Y cell line using XTT and crystal violet assays and imaging. Contribution. In this work we have demonstrated that cytotoxic effect of carbon nanospheres can be attenuated by varying the conditions of synthesis.

Carbone nanosphere, Neurotoxicity, Sol-gel


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**Introduction**

Different nanomaterials are wildly investigated nowadays to be used for different biological applications, such as drug delivery, imaging, anticancer therapy, etc. Alongside with benefits, some materials present severe side effects: cells integrity disruption, metabolism modification, nuclei alterations among others.

Carbon nanoparticles (fullerenes, nanotubes and graphene) were promising materials for biological applications due to their biocompatibility, high surface area and chemical stability. However, in some cases they also present undesirable effects in biological studies. Carbon nanospheres are relatively new carbon nanometric-scaled material. Due to their high surface area and easiness to be functionalized and/or loaded with therapy agent, carbon nanospheres were extensively investigated. For instance, different carbon nanosphere materials were tested as imaging agents, drug delivery carriers, for phototherapy of cancer giving promising results. Nevertheless, some cytotoxic effects were disclosed for that materials too. It worth mention that almost in all studied cases, carbon nanoparticles were produced by hydrothermal synthesis, thus particles were functionalized with different hydrophilic groups. For that reason, our research group decided to assess cytotoxicity of unfunctionalized carbon nanospheres synthetized by sol-gel method. We hypothesize that unfunctionalized material will present different cytotoxic pattern on cell culture.

**Methodology**

Synthesis. For carbon nanospheres synthesis two-step method proposed by Liu et al was used. At the first step polymeric spheres were synthesized from resorcinol and formaldehyde under different temperatures and synthesis time. At the following step, polymeric materials were carbonized at 900 °C under nitrogen atmosphere for 3 h.

Resulted carbon materials were named SG-1, SG-2 and SG-3.

Characterization. All materials were characterized by scanning electron microscopy. RAMAN and FTIR spectra also were obtained for the materials.

Biological experiments. Neuroblastoma SH-SY5Y cell line was used to evaluate neurotoxic effect of carbon nanospheres. Cells were grown in Dulbecco modified Eagles minimal essential medium supplemented with 10% of fetal bovine serum until they reached confluency. SH-SY5Y were plated at $10^5$ concentration into 96-well plate for 24 h. After that, cells were incubated with different concentrations of nanospheres separately for 24 h. XTT assay was performed using standard protocol. Crystal violet (CV) assay was performed on the same cell culture immediately after XTT assay. The results were normalized to control. For cytoskeleton and nucleus staining, cells were plated on microscopy crystals for 24 h prior the staining. The staining was performed with Phallloidin-FITC and DAPI.

**Results**

Synthesis and characterization.

Scanning microscopy images have shown that particles of three studied materials possess spherical shape with diameters 600-700 nm, approximately.

FTIR have not evidenced any functional group peaks, which is consistent with temperature of carbonization.

RAMAN spectra have demonstrated only D and G bands, giving crystallinity ratio of materials of 60-70%.

Biological studies.

Since XTT assay evaluate mitochondrial activity of cells and CV depicts total biomass, both tests should be performed in order to assess effect of nanoparticles on cell culture. 4 different concentrations of carbon nanospheres were implemented: 50, 100, 150 and 200 µg/mL.

XTT and CV assay results are shown at Graphic 1 and Graphic 2, respectively.
The results showed that the material SG-1 present greater dose dependent cytotoxic effect on neuronal cells, giving almost 50% cell activity reduction. Cytotoxic effect of SG-2 and SG-3 is more moderate, with approximately 10% of mitochondrial activity reduction. We suppose that these differences may be caused by different surface geometry, such as pore size and its distribution, that resulted from distinct synthesis conditions. It is known that larger porosity leads to higher surface area, which may cause better interaction between particle and cell membrane.

This effect cannot be attributed to different cell mass, since CV assay did not show it decline, but rather it increases in some extend. For better understanding of particle-cell interactions, staining of cells after their exposure to the materials was performed (Figure 1).

The images showed that SG-1 is more damaging for both cytoskeleton and nucleus, meanwhile, SG-3 did not present significant differences comparing to control.

Conclusions

Neurotoxic effect of unfunctionalized carbon nanosphere materials such as loss of cytoskeleton integrity and nuclei damage can be attenuated by different conditions of synthesis.

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Classification of emotions from the recognition of facial expressions applied to the prevention of secondary Alexithymia: an analysis of the state of the art

Clasificación de las emociones a partir del reconocimiento de las expresiones faciales aplicadas a la prevención de la alexitimia secundaria: un análisis del estado del arte

PADILLA-NAVARRO, Christian†*, ZARATE-TREJO, Carlos, KHALAF, Georges and FALLAVOLLITA, Pascal

Universidad Politécnica de Juventino Rosas, Mexico.
University of Ottawa, Canada.

ID 1st Author: Christian, Padilla-Navarro / ORC ID: 0000-0002-8241-3225, CVU CONACYT ID: 427341
ID 1st Coauthor: Carlos, Zarate-Trejo / ORC ID: 0000-0002-7417-8544
ID 2nd Coauthor: Georges, Khalaf / ORC ID: 0000-0003-2969-6905
ID 3rd Coauthor: Pascal, Fallavollita / ORC ID: 0000-0001-7254-8962

DOI: 10.35429/JSTA.2020.17.6.14.17 Received: January 10, 2020; Accepted: June 30, 2020

Abstract

Alexithymia is a condition that partially or completely deprives you of the ability to identify and describe emotions, and to show affective connotations in the actions of an individual. This problem has been taken to different research projects that seek to study its characteristics, forms of prevention, and implications, and that try to determine a measurement for the experience of an individual with this construct as well as the responses they provide to certain stimuli. Other studies that were reviewed aimed to find a connection between the responses of subjects diagnosed with alexithymia when facing a dynamic of emotional facial expressions to recognize and their assigned grade based on the Toronto Alexithymia Scale (TAS), a metric frequently used to evaluate the presence or absence of alexithymia in an individual. In this work, a review of the different articles that study this connection, as well as articles that describe the state of the art of the implementation of artificial intelligence algorithms applied to the treatment or prevention of secondary alexithymia is presented.

Alexithymia, Emotion Classification, Facial Expressions

Resumen

La Alexitimia es una condición que priva parcial o completamente de la capacidad de identificar y describir emociones y de mostrar connotaciones afectivas en las acciones de un individuo. Este problema ha sido llevado a distintos trabajos de investigación en los que se busca estudiar sus características, formas de prevención e implicaciones, así como determinar en qué medida un individuo experimenta este constructo y las respuestas que proporciona ante ciertos estímulos. Por otra parte, los estudios que se revisaron pretendían encontrar una conexión entre la capacidad de respuesta de sujetos diagnosticados con Alexitimia, frente a una dinámica de reconocimiento de expresiones faciales emocionales, con respecto de su graduación en la Toronto Alexithymia Scale (TAS), métrica usada con frecuencia para evaluar la presencia o ausencia de Alexitimia en un individuo. En este trabajo, se presenta una revisión de los distintos artículos que estudiaban dicha conexión, así como el estado del arte respecto a la implementación de algoritmos de inteligencia artificial aplicados al tratamiento o prevención de Alexitimia secundaria.

Alexitimia, Clasificación de Emociones, Expresiones Faciales

Introduction

The term “alexithymia” was proposed by Peter Sifneos, a Greek psychiatrist and researcher who used it to refer to the deficit of cognitive-affective factors belonging to the communication capacity of psychosomatic patients. Etymologically means “no words for feelings”, and this condition involves the reduction or even the complete annulment of an individual's ability to understand, identify, and verbally describe emotions.

Today, there are numerous research works carried out around alexithymia focusing on the effects it has on individuals diagnosed with this condition. These works constitute an important factor for the development of treatments and measures of prevention, as well as a branching point for the writing of deeper research based on the conclusions already obtained.

Alexithymic subject context

The alexithymic patient lacks empathy for others, which severely affects their social relationships as the lack of empathy is perceived to be a negative attitude by the people around them, resulting in their detachment from the patient. In addition, they present difficulties in carrying out activities that require interpersonal interaction.

It should be noted that two important groups of alexithymia are considered to exist: primary and secondary.

Primary alexithymia refers to abnormalities at the neurobiological level and may be associated with chronic diseases. In contrast, secondary alexithymia is caused by interpersonal issues such as deep depression, repression of emotions, or even traumatic circumstances. Consequently, it is important, at least as a measure to prevent secondary alexithymia, to receive emotional education at an early age in order to identify and openly express emotions. This teaches how to regulate emotions while generating an expressive personality in the subject.

The alexithymic individual is not a creditor of complications or a malfunction of his limbic system, a section of the brain made up of the thalamus, hypothalamus and the cerebral amygdala, whose function resides in regular memory, emotions, hunger and sexual instincts.

In fact this set of organs probably did not acquire the natural relevance that it should or that due to being considered useless or a sector of vulnerability for the individual, he or she chooses to decline possible dependencies towards said system as happens in the profile of the secondary alexithymia. In retrospect, disconnection with the emotional world implies that an individual projects logical and critical reasoning in decision-making, an act based on a concrete vision of the context without considering improvised options.

Of course, the inability to interpret the emotional cues under which other people communicate is not equivalent to assuming that a subject with a high degree of alexithymia is literally emotionless. Dr. De La Serna J. Moises expresses in his work "Alexithymia, A World Without Emotions" that alexithymia is a state that reflects the consequences of other conditions, so it is not considered a disease. That is why it is referred to as a "construct" or simply a qualitative personality trait to a lesser or greater degree.

Consequently, alexithymia begins to take part in the development of psychosomatic disorders. This does not imply that alexithymia causes them but increases the probability that they will manifest. The emotional repression described by alexithymia induces in the subject a condition of "emotional somatization". Among the cases associated with this context is hypertension. Although it is true that hypertension is related to overweight, alcohol consumption and even disorders of the endocrine system, when analyzed from the psychosomatic point of view, it is concluded that it may be the manifestation of the containment of hostility in the subject.

Alexithymia generally does not represent a major problem in the professional environment, unless it requires a process of continuous interpretation and response of affective connotations.
Article selection criteria

Technological tools, specifically based on artificial intelligence, have been important allies in the search of solutions for mental health issues, with alexithymia being one of these issues.

This research presents a deep search in the state of the art of the fundamental contributions of artificial intelligence tools focused on the detection or prevention of alexithymia, as well as research focused on the detection of facial expressions to diagnose alexithymia.

To carry out this review, only studies involving the recognition of emotional expressions from visual, textual, or acoustic sources of information that are used as stimuli to generate responses in individuals diagnosed with alexithymia, and that made use of a metric to evaluate the degree of the alexithymic condition of the subjects studied are selected. Additionally, any study or research work involving the use of artificial intelligence for the treatment, prevention, or study of alexithymia was included. Finally, these studies had to be published from 1990 onwards, either in Spanish or in English.

Deficiency in the ability to recognize nonverbal emotional expressions

Literature shows that several investigations described some factors that are typical in cases of alexithymia present even in patients who are drug users, suffering from personality disorders, depression, and panic among others.

According to the research work “Alexithymia and the Recognition of Facial Expressions of Facial Expressions of Emotion” by D. A. James, individuals with alexithymia have deficits in the perception of nonverbal emotional expressions.

The study consists of presenting a group of 131 women and 85 men a set of slides in which poses of facial expressions representing nine different emotions were shown. Each member of the group was asked to identify the emotion that the person in the photograph displayed.

Subsequently, they are evaluated using the 20-question version of the TAS test (Toronto Alexithymia Scale), with which groups of high, moderate, and low presence of alexithymia were determined. The results of the study showed that the group evaluated with a high degree of alexithymia presented a greater difficulty in identifying the expressions in the photos, in contrast to the group of lesser degree, which obtained a higher rate of success.

Similarly, the work carried out by M. S. Francisco at the University of Murcia, Spain, developed the same evaluation using TAS-20; however, contrary to the previous work, its methodology consisted in carrying out the test “Reading the mind in the eyes”, which consists of matching the expression shown in the eye regions with one of four possible emotions. The results suggest that individuals with a high presence of alexithymia could develop less detailed cognitive representations of facial expressions, making it difficult to identify and assimilate their emotional meaning.

This same pattern is repeated even in works where the source of cognitive stimulation is acoustic. In the research “Cognitive biases in the recognition of emotional expressions of synthetic voice in Alexithymia”, also developed by M. S. Francisco, it is explained that even when individuals are subjected to a dynamic of emotional expression to recognize based on the the tone of the voice identified, very similar results to those seen in previous evaluations are provided.

Implementation of Artificial Intelligence tools applied to the detection and prevention of Alexithymia

Artificial intelligence is a field of computer science that is responsible for the study and development of models, programs, and tools whose behaviors can be considered “intelligent”. When an artificial intelligence model is developed, the algorithm that is used to train it is chosen according to the problem that is to be solved. These problems can include, but are not limited to: classification, regression, or segmentation.
Although the mathematical bases for the integration of these algorithms were developed decades ago, this field has been growing in recent years. This in part thanks to the implementation of more powerful computer equipment and technologies dedicated to solving these types of problems, as well as their segmentation into specialized areas, of which many are yet to be explored.

This may be one of the reasons why there is a lack of work where the use of artificial intelligence is implemented in the treatment of alexithymia. However, a research paper published in 2019 at the Universidad Internacional de la Rioja and developed by A.M. Raúl describes the development of a tool that performs an evaluation to detect alexithymia using Natural Language Processing (NPL) techniques.

This work is based on an important characteristic consistent with the alexithymia already evidenced in the studies presented: the difficulty to verbally express emotions. With this work, the methodology presented consists in the construction of a model that can estimate the degree of alexithymia of a subject based on the analysis of a writing prepared by it.

Similarly, the TAS-20 metric is used as a reference to carry out the inferences of the degree of alexithymia that is presented in the individual based on NPL tools provided by IBM, Google, and Microsoft that are applied to the identification of emotional polarity in texts. Within its conclusions, it is affirmed that it is completely possible to make use of narratives as a source of data to evaluate the presence of alexithymia in a person without resorting to self-reports. A success rate of 82.4% was acquired in the pilot test applied to a group of 122 people.

Conclusions

In the current investigation, an important pattern was identified in people suffering from alexithymia regarding their ability to respond correctly to visual and acoustic cognitive stimuli. In addition, the use of artificial intelligence applied to the treatment of alexithymia is a rather scarce topic. The literature found mainly focused on the search for a method to automatically detect and evaluate the degree of alexithymia.

Finally, we determined that at this time, a research work that implements preventative measures for secondary alexithymia using an algorithm of artificial intelligence is not found in the state of the art.

References


Development of a coating with UV protection for leather finishing in the automobile industry

Desarrollo del recubrimiento para protección a los rayos UV del acabado del cuero para la industria automotriz

AGUILAR-MARURI, Saul†*, VALENCIA-RODRÍGUEZ, Samantha†, GALINDO-GONZÁLEZ, Rosario‡ and FUENTES-RAMÍREZ, Rosalba*†

University of Guanajuato, Department of Chemical Engineering, Noria Alta SNP, Col. Noria Alta, C.P. 36050, Guanajuato, Guanajuato, Mexico.

* Correspondence to Author (Email: rosalba@ugto.mx)
† Researcher contributing as first author

ID 1st Author: Saul, Aguilar-Maruri / ORC ID: 0000-0002-1656-472X, CVU CONACYT ID: 955004
ID 2nd Author: Samantha, Valencia-Rodriguez / ORC ID: 0000-0002-4188-3028, CVU CONACYT ID: 782949
ID 3rd Author: Rosario, Galindo-Gonzalez / ORC ID: 0000-0002-3612-1555, CVU CONACYT ID: 223987
DOI: 10.35429/JSTA.2020.6.18.25

Received: January 09, 2020; Accepted: June 29, 2020

Abstract

Due to continuous use and environmental factors (humidity and continuous exposure to the sun), the leather upholstery experiences cracking, discoloration and possible yellowing. The above factors significantly decrease the life of leather upholstery in cars. The objective of this work is to synthesize zinc oxide nanoparticles, which have optical properties that allow it to absorb UV radiation and then incorporate them into a polymeric matrix to develop a coating with UV protection for leather finishing in the automobile industry. The particles of zinc oxide were synthesized by the sol-gel method to obtain a nanometric particle size, this method represent a low-cost synthesis method, without the use of surfactants and easily scalable. With monoethylene glycol was formed a stable colloid with the zinc oxide nanoparticles and the polymer matrix. Finally, the final leather finishing obtained for the automotive industry has greater resistance to bending, also thermal stability was improved. In consequence, the lifetime of the leather finishing has improved.

UV radiation, Zinc oxide nanoparticles, Leather finishing


Resumen

Debido al uso continuo y los factores ambientales (humedad y exposición continua al sol), la tapicería de cuero experimenta grietas, decoloración y posible amarillamiento. Los factores anteriores disminuyen significativamente la vida útil de la tapicería de cuero en los automóviles. El objetivo de este trabajo es sintetizar nanopartículas de óxido de zinc, que tienen propiedades ópticas que le permiten absorber la radiación UV y luego incorporarlas en una matriz polimérica para desarrollar un recubrimiento con protección UV para el acabado del cuero en la industria automotriz. Las partículas de óxido de zinc se sintetizaron mediante el método sol-gel para obtener un tamaño de partícula nanométrico, este método representa un método de síntesis de bajo costo, sin el uso de tensoactivos y fácilmente escalable. Con monoetilenglicol se formó un coloide estable con las nanopartículas de óxido de zinc y la matriz polimérica. Finalmente, el acabado final del cuero obtenido para la industria automotriz tiene mayor resistencia a la flexión, también se mejoró la estabilidad térmica. En consecuencia, la vida útil del acabado del cuero ha mejorado.

Radiación UV, Nanopartículas de óxido de zinc, Acabado de cuero


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Introduction

Currently, the impact of UV rays in humans has focused on how it causes damage to the structure of collagen, but there are few references of the impact that UV radiation has on leather finishing materials (A. J. Bailey, 1980). In the bibliography, the inclusion of inorganic compounds such as carbon materials and metal oxides to polymeric matrices improves mechanical properties and thermal resistance to leather finishing (Pavel, 2011). Zinc oxide has an excellent absorption of UV radiation material (L. Wallenhorst, 2018), so it is widely used in the manufacture of sunscreens.

The synthesis of metal oxides by the Sol-Gel method implies: simplicity, low cost, reliability, repeatability, relatively simple synthesis conditions (low synthesis temperatures, minimum evaporation loss, minimum contamination), favourable optical properties, higher surface area, greater purity, better microstructural control of metal particles and narrower distributions of particle and pore (J. F. De Lima, 2012).

Many leather finishing use polyurethanes (C. Niculescu, 2012) like film protectors because they have high abrasion resistance, superior hardness, elastomeric properties, good chemical resistance, tensile strength, high extensibility at low temperature and properties that are simple to modify. In this work, a mixture of polyurethane resins and dispersants (provided by leather finishing industry), a polymeric matrix, with inserts of zinc oxide nanoparticles was used as the finishing material and applied by the spray coating technique.

Methodology

For the synthesis of nanoparticles of ZnO is necessary a five-step method, as indicated by (S. Jurablu, 2015) and the modifications made by (Valencia-Rodríguez, 2018).

Solubility and solvent-polymer matrix compatibility tests of the nanoparticles were performed in: 1. Isopropanol, 2. Polyethylene glycol, 3. Ethanol, 4. Ethanol-water mixture (1:1), 5. Monoethylene glycol, 6. Methanol and 7. EEP (ethyl 3-Ethoxypropionate).

5 layers of the polymer matrix, nanoparticles, and pigment (provided by the company) were applied (by pressure gun), with and without nanoparticles. It was dried in a convective heating oven at 90 °C for 3 minutes. Previous tests were exposed to solar radiation for 70 days, and it was considered an unexposed reference sample.

All materials were characterized by X-ray diffraction UV-Vis spectroscopy, diffuse reflectance UV-Vis spectroscopy, Scanning electron microscopy (SEM), Raman spectroscopy, Fourier transform IR spectroscopy, Thermogravimetric analysis (TGA) and Chronoamperometry. Evaluation of the colour difference (ΔE *), in applied samples to leather finishing, were with a colorimeter.

Results

The samples were prepared by the sol-gel method using different pH's (Figure 1 and 2) the results confirmed the wurtzite hexagonal phase whose characteristic peaks are located at 32.24°, 34.42°, 36.25°, 47.54°, 56.84°, 62.86° and 68.76° corresponding to the diffraction planes (100), (002), (101), (102), (110), (103) and (112). With Graphic 1 it follows that the sample analysed has no impurities and small particles have good crystallinity. Graphic 2 also indicates wurtzite phase without impurity residues but the peaks in the diffractogram of the oxide indicates a lower degree of crystallinity. The previous results are due to the pH of synthesis, 9 and 11, respectively (L. Li, 2010), (Thambidurai, 2017).

![Graphic 1 Diffractogram of ZnO nanoparticles synthesized via sol-gel at pH 9](source: own work [OriginPro 9])
Development of a coating with UV protection for leather finishing in the automobile industry. Journal of Scientific and Technical Applications. 2020

Graphic 2 Diffractogram of ZnO nanoparticles synthesized via sol-gel at pH 11
Source: own work [OriginPro 9]

Graphic 3 represents the absorption spectra by UV-Vis spectroscopy, with an absorption band at 370 nm. The presence of the highest absorption peak at 355.78 nm is observed, which confirms the presence of zinc oxide nanoparticles in the solution (Pavel, 2011), (W. A. G. Bruls, 1984). Also, the Graphic 3 corresponds to the ZnO obtained by method at pH 11, it is observed that the wurtzite phase is also obtained without residues of impurities. The peaks of this diffractogram are less intense, so this material has a lower degree of crystallinity than the previous one (at pH 9). Direct banned band energy was calculated from the Planck equation (Eq. 1) taking as reference the peak of greatest absorption obtaining $E_{\text{gap}} = 3.49$ eV.

$$E_{\text{gap}} = \frac{hc}{\lambda}$$

Where:
- $h =$ Planck constant $(6.626 \times 10^{-34} \text{ joules})$.
- $c =$ speed of light $(c = 3 \times 10^8 \text{ m/s})$.
- $\lambda =$ peak absorption wavelength $(3.557836 \times 10^{-7} \text{ m})$.

Considering the diffuse reflectance UV-Vis spectroscopy, the sample absorption coefficient (at pH 9 and 11) for each wavelength was estimated and it was graphed $(\alpha \lambda) \text{ vs } (\lambda)$ (Graphic 4), for energy estimation forbidden band with Kubelka-Munk model for which $E_{\text{gap}} = 3.25$ eV was obtained. For both cases, the value is close to that reported in the bibliography for the ZnO, $E_{\text{gap}} = 3.37$ eV (M. Shaban, 2016).

Forbidden band energy is influenced by several nanoparticle factors such as morphology, particle size, composition and the presence of defects (oxygen vacancies), (A. K. Zak, 2011).

Graphic 4 Kubelka Munk graph of ZnO synthesized by the sol-gel method at pH 9
Source: own work [OriginPro 9]

Graphic 5 shows that the peak of the highest intensity of the spectrum was located around $438 \text{ cm}^{-1}$ and is due to the $E_2$ (high) mode, which is a typical Raman peak of the wurtzite ZnO phase (Golzary, 2014). The spectrum shows peaks around $213.12 \text{ cm}^{-1}$, $326.94 \text{ cm}^{-1}$, $336.67 \text{ cm}^{-1}$, $436.67 \text{ cm}^{-1}$, $559.51 \text{ cm}^{-1}$, $583.44 \text{ cm}^{-1}$ which are also attributed to the wurtzite phase. For zinc oxide in the wurtzite phase, 6 first-order vibrational modes are expected, assigned as $A_1$, $E_1$, $2E_2$ Y $2B_1$ (C. A. Arguello, 1969). Modes $A_1$ and $E_1$ are polar and break in optical transverse (TO) and longitudinal optical (LO) phonic modes. The modes $E_2$ ($E_2^{\text{LOW}}$, $E_2^{\text{HIGH}}$) are non-polar and active in the Raman spectrum.
The band observed around 213.12 cm\(^{-1}\) is attributed to the \(E_2^\text{LOW}\) mode of the ZnO in the wurtzite phase. The vibrational modes that appear around 336.67 cm\(^{-1}\) and 436.67 cm\(^{-1}\) in our spectrum are attributed to modes \(A_1(\text{TO})\) and \(E_2^\text{HIGH}\) (associated with oxygen subnet in ZnO) of the wurtzite phase. The band that appears in 583 cm\(^{-1}\) is attributed to the ZnO mode \(A_1(\text{LO})\) of the wurtzite phase (al. H. Z., 2002). The peak observed in 326.94 cm\(^{-1}\) is attributed to the second-order Raman process characteristic of the wurtzite phase. The signal marked with an asterisk is attributed to the formation of ZnO(OH)\(_2\) (P. Kumar, 2018).

Graphic 5 Raman spectrum of the ZnO sample synthesized at pH 9
Source: own work [OriginPro 9]

Graphic 6 corresponds to the infrared spectrum of synthesized ZnO, the signal observed in 452 cm\(^{-1}\) is characteristic of the stretching vibrations of the Zn-O bond (Soto-Robles, 2017), (Prasad, 2018).

Graphic 6 The infrared spectrum of synthesized ZnO
Source: own work [OriginPro 9]

Graphic 7 shows the TGA results of the ZnO. It can see three stages of weight loss. The total weight loss of 9% for nanoparticles dried for 2 h at 60°C. In the first stage, a small amount of weight loss (1.5%) is observed at temperatures below 141°C, which is considered as the dissociation of weakly bound solvent molecules, such as methanol (D. Sun, 2007). The second stage is between 141°C and 386°C, in which the most significant weight loss is observed, in this range 6.2% is lost, and this stage is followed by the third stage of weight loss in which a slow weight loss was observed until reaching 9% of weight lost at 600°C. The second stage can be attributed to acetate ions which are difficult to remove during washing and to the possible presence in a smaller amount of Zn(OH)\(_2\) (al. L. L., 2018).

Graphic 7 TGA of ZnO nanoparticles synthesized via sol-gel
Source: own work [OriginPro 9]

Figure 1 (a, b, c and d) show that the nanoparticles have a homogeneous and spherical shape. The formation of nanoparticle clusters is observed in better detail in the Figure. In the four micrographs presented, it is observed that the size of the nanoparticles that form the clusters is less than 100 nm.
Figure 1 SEM micrographs of ZnO nanoparticles
Source: own work [JEOL SU 3500 SEM Hitachi]

Graphic 8 shows the impedance spectrum corresponding to the films made with prepared solutions of 0.1%, 0.3% and 0.5% w/w ZnO in methanol. It is observed that as the concentration increases the resistance of the film decreases. The same trend is followed in Graphic 9 which corresponds to the spectrum of films made with solutions of ZnO AL 1%, 3% and 5% w/w, in methanol. This corroborates the semiconductor capacity of the material, the higher the concentration, the better the conductivity.

Graphic 9 Electrochemical Impedance Spectrum of ZnO particles at concentrations 1%, 3%, 5% in methanol
Source: own work [OriginPro 9]

Graphics 10, 11, 12 and 13 describe the chronoamperogram of the film formed with 0.3%, 1%, 3% y 5% w/w ZnO in methanol, it is observed that at a higher concentration of ZnO the amount of UV light it absorbs is less. This is because the ZnO disperses the incident radiation on the film. It is also observed that when the concentration of the nanomaterial is increased, the absorption intensity remains constant, which encourages believing that it can be irradiated with UV light for long periods.

Graphic 10 Chronoamperogram of a 0.3% w/w ZnO film in methanol
Source: own work [OriginPro 9]
It was decided to use monoethylene glycol as a dispersing phase for the ZnO nanoparticles, due to the non-formation of agglomerates in the films applied on the substrates, as shown in Figure 2.

The samples applied to leather finishing were exposed to solar radiation for 70 days, and it was considered an unexposed reference sample. The evaluation of this samples was with a colorimeter, colour difference (ΔE*), as shown in Table 1.

Table 1 Application of films, with ZnO nanoparticles synthesized via pH 9 sol-gel, in leather substrate, dispersed in monoethylene glycol

<table>
<thead>
<tr>
<th>Number of layers applied on the substrate</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colorimetric parameter evaluation, b*</td>
<td>Δb: 9.52</td>
<td>Δb: 8.38</td>
<td>Δb: 6.26</td>
<td>Δb: 3.04</td>
<td>Δb: 2.69</td>
</tr>
</tbody>
</table>

Conclusions

The sol-gel method represents a simple synthesis method with low cost and high productivity ZnO. UV-Vis spectroscopy with diffuse reflectance and chronoamperometries confirmed the good absorption of UV radiation from the synthesized ZnO. The sample irradiated by sunlight that contained ZnO nanoparticles in the leather finish was preserved in a better state than the one that did not contain nanoparticles. The addition of ZnO nanoparticles to the leather finish layers greatly improved their mechanical properties and thermal stability. The Δb value was reduced by 74%, a value of 2.69 was obtained for this parameter, which is only 0.69 units above the maximum allowed value (Δb: 2).
Acknowledgments

This project was conducted under the results from project IJ – 236 -2019.

To “Centro de Investigaciones en Óptica, A.C.” for the contribution with SEM micrographs of ZnO nanoparticles.

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[Title in Times New Roman and Bold No. 14 in English and Spanish]

Surname (IN UPPERCASE), Name 1st Author†*, Surname (IN UPPERCASE), Name 1st Coauthor, Surname (IN UPPERCASE), Name 2nd Coauthor and Surname (IN UPPERCASE), Name 3rd Coauthor

Institutional Affiliation of Author including Dependency (No.10 Times New Roman and Italic)

International Identification of Science - Technology and Innovation

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General explanation of the subject and explain why it is important.

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