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## ANALYSIS OF THE SONOROUS WAVES PRODUCED IN STRING MUSICAL INSTRUMENTS WITH SADDLES OF DIVERSE STUFF BETWEEN THEM THE SiC RE-COVERED WITH CVD DIAMOND FILM.

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**Keywords:** Carbide Silicon (SiC), Diamond Film, hot filament CVD, Sound Waves

### Abstract

All the vibrations produced by the strings of a musical instrument as the Spanish guitar, are transmitted by the saddle, of the string's instrument up to its resonance box. Of that form, the sound instrument is altered in function of the kind of stuff of which such piece is deed. The stuffs utilized in this study were: ABS, Nylon, Bone of Ox, SiC and SiC re-covered with Diamond CDV (density of 3.50 g/cm<sup>3</sup>). The choice of the SiC refers the facility with that this stuff permits the growth of the diamond film, which possessed a high speed of sound propagation of 18.000 km/s [1]. The study was carried out in a Spanish guitar and was first carried out the preparation of the saddle. The acquisitions of the sonorous waves were obtained by means of a body pickup connected to an Oscilloscope Tektronix. Of the analysis carried out, confirmed itself to predicted difference between waves in function of the stuff of the saddle and established itself better in the capture of the sound when utilized the saddle of SiC re-covered with Diamond film.

### 1-Introduction

The sound is a phenomenon of mechanical nature and because of that need a material for be manifested and spread.

Before of anything, the sound, is a wave and being like this, it presents a series of characteristics.

The sonorous waves are produced by deformations provoked by the difference of pressure in any elastic environment (air, metals, isolates, etc), being necessary this environment to spread. In this way, we perceive that the sound is a mechanical wave, not spreading in the vacuum.

The sounds are obtained because of the objects vibrations, as is the case of the loudspeaker. When the diaphragm contained in the loudspeaker itself enliven for outside of the acoustic box creating a region of high pressure, therefore compresses the air that is in the proximities. Of the same form, a "vacuum" occurs when the diaphragm moves for inside the box.

The sonorous waves are longitudinal mechanical waves that are able to spread in solids, liquid and gases. In the longitudinal waves the oscillations of the particles that compose the material are parallel to the direction of the wave way.

In case of the sound transmission by a solid material the waves are transmitted by vibrations, atom by atom, being then straightly related with the forms by the atoms are connected. Then, is easy to conclude that the diamond should be a stuff that

present goods estates relatives the waves transmission.

There're many studies being carried out exist as to acoustic waves device with the application in telecommunication industry [1]. However, the acoustic researches of the diamond have limited mainly the application in SAW (device). This project comes for exploit another branch of the acoustic estates of the diamond that is the application in musicals instruments. Studies relating the diamond with stuff piezoelectric has shown promising, by example with devices based on ZnO/polycrystalline diamond/itself layered structures has been reported, where the diamond layers has been grown by hot filament or chemical vapor deposition (CVD). [2-7]

Is of knowledge that the diamond is capable of transmit waves with bigger speed [8], being able to the speed arrive to 18.000 km/s.[8] The diamond application in musicals instruments is somewhat unusual of be carried out, however, on the basis of this estate, we have the intentions of evaluate the possibility of a new line of products, of high performance, destined for the musical application that utilize the estates of the diamond for provide earned and better vantages in the transmission of waves.

In the musicals instruments the sound is produced in consequence of the vibration of a part of the instrument which by some environment is transmitted for our ears. In a acoustic guitar, by an

external stimulate, produces vibration of the cords. However, for the sound to be audible and with the tone that characterizes the instrument is necessary that the vibrations of the cords are transmitted for the resonance box of the instrument. That transmission happens by a piece that stayed between the cord and the resonance box, this piece is call of saddle. Then, the vibrations of the cords are transmitted for the resonance box by a solid environment which influence straightly in the final quality of the sound that the instrument is capable to produce.

The objective of this paper is present the analysis that was carried out in an acoustic guitar about characteristics soundless obtained in the transmission of waves varying itself the stuff of which the saddle is composed. It were utilized the most common stuff for this available application, being it: Nylon (density of  $0.97 \text{ g/cm}^3$ ), ABS (density of  $0.91 \text{ g/cm}^3$ ), and Bone of ox (density of  $1.97 \text{ g/cm}^3$ ). Also it was utilized a saddle composed of SiC (density of  $3.00 \text{ g/cm}^3$ ) and of SiC recover with a film of CVD Diamond (density of  $3.50 \text{ g/cm}^3$ ). Analyses referring the waves that each stuff is capable to produce are present in this paper and the result of this is that the SiC recovered with CVD diamond is capable to better the propriety about sound conduction.

## 2-Experimental

This experimental part refers to the preparation of the saddles and the wave acquisition, being used an acoustic guitar to it.

### 2.1- Adjust of the dimensions of the saddles.

All the saddles utilized for the experiments were adjusted for similar dimensions in order for dimensions of these not alter the results it will be obtained.

The dimensions was:  $80 \times 5,5 \times 2,25 \text{ mm}$ .

### 2.2- Preparation of the subtracts of SiC

The Carbide of Silicon utilized, was developed in ours own institute by the laboratory of pottery, being that the samples utilized for study presented a density of  $3,00 \text{ g/cm}^3$ .

In this phase of the project was carried out the preparation of the SiC subtracts that was comprised of the following paces:

- Cut of the samples in the such of the saddle.
- Scouring of the sample surfaces with diamond paste, such procedure is going to leave the sample with a good superficial finish for that have not problems in the phase of film formation



Fig. 1: Samples of SiC cut in the dimensions of the guitar saddle.

### 2.3- Deposition of the CVD diamond in the sample of SiC.

Was carried out the deposition of diamond CVD using a reactor of hot filament. The conditions of growth of the film was studied parallel, finding the best conditions (temperature, pressure and saturation of gas) for the diamond presents an acceptable growth and morphology.

The conditions of film deposition with  $100 \text{ sccm}$  of gas mixture, with  $2\%$  of methane in a temperature of  $800 \text{ }^\circ\text{C}$ , with  $50 \text{ Torr}$  provide the film with better homogeneity regarding the size of grain in the surface. In the fig.2 we are able to observe a picture carried out by MEV of the film of CVD diamond in the surface of the sample.

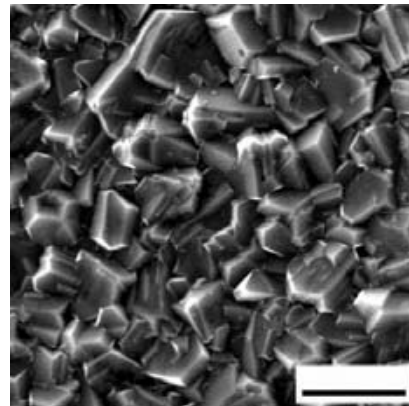


Fig.2: Picture of diamond CVD take with MEV, with enlargement of  $5000\times$ .

### 2.4-Waves acquisition:

A pickup utilized in the body of the musical instrument was connected to a Tektronix oscilloscope, in which the waves produced were observed. The touch of the cord of the guitar was carried out by means of a device that was created, with the intention is perform the touch of the cord always with a same intensity.

This assembly showed simple and efficient for the analysis that is proposed.



Fig.3: waves acquisition using a pickup connect with the oscilloscope Tektronix

Utilizing the assembly described was carried out a first analysis of referring waves produced by the peculiar kinds of stuff of saddle. For each one of those stuffs was deeds analyses, finding uncover differences in the forms of waves that the use of each material is capable to produce.

The analysis of the waves was first carried out for the third cord of nylon of bass for top. The choice of be done a first analysis in this cord is because of the fact of this cord present a smaller frequency of wave, what facilitates the viewing of the waves in the oscilloscope, because the space between them is bigger.

### 3-Results

In the fig.3, are presented the preliminary waves that were obtained with the Oscilloscope Tektronix, when touched the cord with the instrument equipped with a ABS saddle.

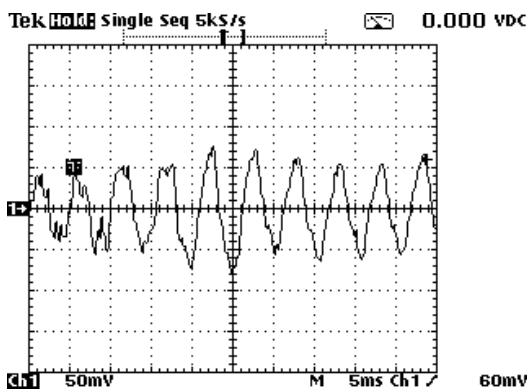


Fig. 3: Waves acquisition using an ABS saddle when the 3<sup>th</sup> string is touch

The ABS saddle is cheap and utilized in poplars instruments. This stuff is not seen, by experts in musicals instruments, as an excellent stuff for the utilization in saddle.

The wave presented in the fig.4, refer to the waves produced using nylon saddle in the instrument.

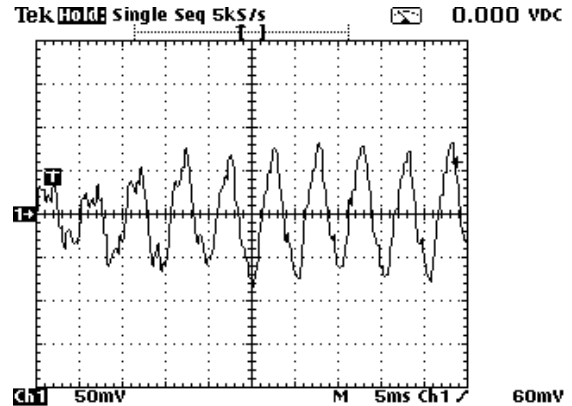


Fig.4: Waves acquisition using a Nylon saddle when the 3<sup>th</sup> string is touch

In a visual analysis, observes-itself that the nylon shows a wave amplitude value a little higher than the ABS saddle. In the fig. 5, is presented the form of wave regarding the saddle of Bone of Ox.

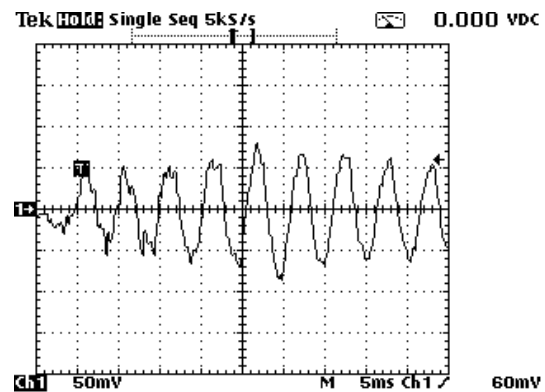


Fig.5: Waves acquisition using a Bone of ox saddle when the 3<sup>th</sup> string is touch

Preliminarily, we can observe a considerable change in the format of the waves in function of the stuff saddle.

The changes in the behavior of the waves produce by the instrument in consequence of the variation of the stuff saddle. Observing the waves obtained, fig. 3-7, note itself as much as changes: the forms of the waves, intensity and maintenance of a given intensity by a given period of time. The waves obtained with the ABS saddle fig. 3, saints that it presented the smallest amplitude and also the more quickly amplitude diminish passing the time. The saddle of SiC recovered with diamond CVD, presented the biggest amplitude of wave and also the biggest maintenance of this, fig. 7.

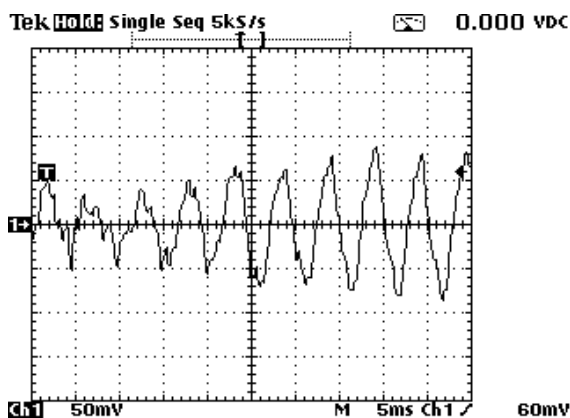


Fig.6: Waves acquisition using SiC saddle when the 3<sup>th</sup> string is touch

The bone saddle showed an intermediate behavior, fig. 5, between the ABS saddle and the Nylon. The SiC saddle even without recovering showed a variation regarding the others stuff. These results are still preliminary, will be still carried out more experiments in order to improve the waves acquisition approach and subsequent analysis

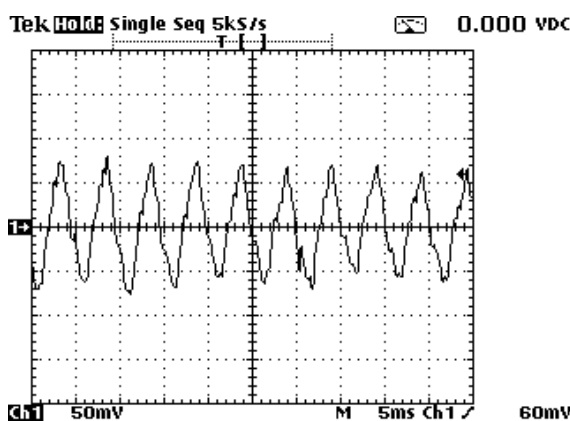


Fig.7: Waves acquisition using a saddle of SiC recovered with CVD diamond, when the 3<sup>th</sup> string is touch

#### 4- Conclusion

The SiC is a stuff that adapts to the capacity of promote the growth of CVD diamond and a great

adhesion of the even, being like this, its application as saddle of cord instrument a big possibility of success for the given ends of improvement in the transmission of the sound, in agreement was observed.

It is possible observe that barely with the utilization of the SiC, variations occur in the waves. The fact of be a ceramic stuff, showed to be a certain and prominent factor contributed for the best observed. The forms as the atoms of the stuff are connected between itself, is straightly related with the constant of elasticity of the stuff. Then, due to the diamond possess a high coefficient of elasticity, wait that the diamond also produces qualities as regards the sound transmission. This work indicates the big possibility of success of the utilization of the diamond in musicals instruments; however, the results are inconclusive, being necessary of other waves analysis form for carry out a numerical analysis more detailed about the qualities that the diamond CVD would bring for this application.

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# SISTEMA DE GERAÇÃO DE ENERGIA ELÉTRICA COM MÓDULOS SOLARES FOTOVOLTAICOS PARA O CARREGAMENTO DE BATERIAS DE UMA CADEIRA DE RODAS ELÉTRICA

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## INTRODUÇÃO

Energia Renovável é todo o tipo de energia produzida a partir de uma fonte natural que não diminui pelo fato da sua utilização ser “renovável”<sup>[1]</sup>. Cada vez mais são utilizados recursos energéticos renováveis, pois estes oferecem múltiplas vantagens tais como a facilidade de produção de energia em pequena escala e por serem totalmente compatíveis com o meio ambiente.

A energia renovável utilizada neste projeto é a energia solar fotovoltaica, conseguida pela conversão direta da energia solar em energia elétrica através do uso de células solares, podendo estas ser de vários tipos, sendo as mais comuns de silício. A grande vantagem do sistema fotovoltaico é a geração de energia elétrica limpa, ou seja, gera energia sem emitir poluente e sem destruir o meio ambiente além de se tratar de uma fonte inesgotável de energia. A principal desvantagem é, ainda, o alto custo e sua baixa eficiência, sendo assim, para que possa continuar desenvolvendo-a é necessário estabelecer mecanismos capazes de viabilizá-la. A busca destes mecanismos de incentivo torna-se muito importante, pois os energéticos renováveis e não convencionais não produzem um retorno financeiro ao investidor propriamente dito, trazendo sim grandes benefícios à comunidade, a sociedade e ao meio ambiente.

A conversão de energia solar em energia elétrica foi verificada pela primeira vez por Edmond Becquerel, em 1839 onde constatou uma diferença de potencial nos extremos de uma estrutura de material semicondutor quando exposto à luz. Em 1876 foi montado o primeiro aparato fotovoltaico resultado de estudos das estruturas no estado sólido, e apenas em 1956 iniciou-se a produção industrial seguindo o desenvolvimento da microeletrônica.

O efeito fotovoltaico dá-se em materiais denominados semicondutores que se caracterizam pela presença de bandas de energia onde é permitida a presença de elétrons (banda de valência) e de outra onde totalmente “vazia” (banda de condução).

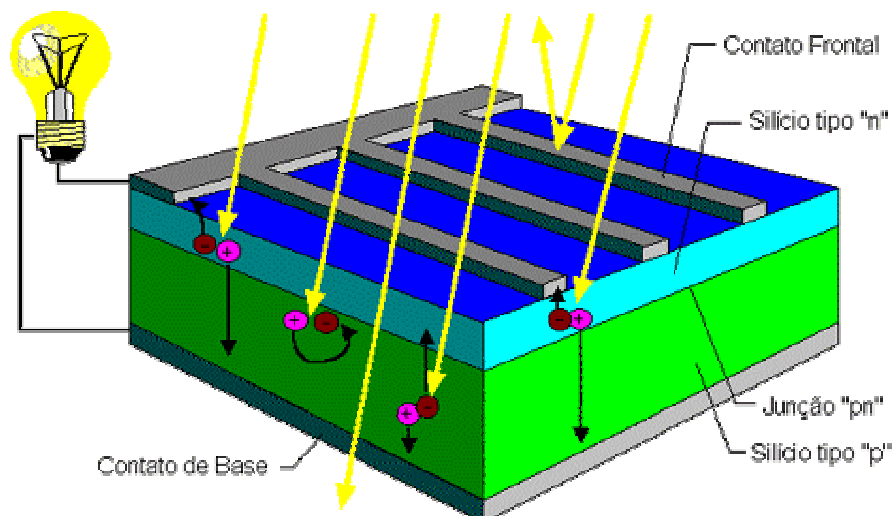
O semicondutor mais usado é o silício. Seus átomos se caracterizam por possuírem quatro elétrons que se ligam aos vizinhos, formando uma rede cristalina. Ao adicionarem átomos com cinco elétrons de ligação, como o fósforo, por exemplo, haverá um elétron em excesso que não poderá ser emparelhado e que ficará “sobrando”, fracamente ligado a seu átomo de origem. Isto faz com que, com pouca energia térmica, este elétron se livre, indo para a banda de condução. Diz-se assim, que o fósforo é um dopante doador de elétrons e denomina-se *dopante n* ou *impureza n*.

Se, por outro lado, introduzem-se átomos com apenas três elétrons de ligação, como é o caso do boro, haverá uma falta de um elétron para satisfazer as ligações com os átomos de silício da rede. Esta falta de elétron é denominada *buraco* ou *lacuna* e ocorre que, com pouca energia térmica, um elétron de um sítio vizinho pode passar a esta posição, fazendo com que o buraco se desloque. Diz-se, portanto, que o boro é um *aceitador de elétrons* ou um *dopante p*.

Se, partindo de um silício puro, forem introduzidos átomos de boro em uma metade e de fósforo na outra, será formado o que se chama *junção pn*. O que ocorre nesta junção é que elétrons livres do lado n passam ao lado p onde encontram os buracos que os capturam; isto faz com que haja um acúmulo de elétrons no lado p, tornando-o negativamente carregado e uma redução de elétrons do lado n, que o torna eletricamente positivo. Estas cargas aprisionadas dão origem a um campo elétrico permanente que dificulta a passagem de mais elétrons do lado n para o lado p; este processo alcança um equilíbrio quando o campo elétrico forma uma barreira capaz de barrar os elétrons livres remanescentes no lado n.

Se uma junção pn for exposta a fótons com energia maior que o *gap*, ocorrerá a geração de pares elétron-lacuna; se isto acontecer na região onde o campo elétrico é diferente de zero, as cargas serão aceleradas, gerando assim, uma corrente através da junção; este deslocamento de cargas dá origem a uma diferença de potencial ao qual chamamos de *Efeito Fotovoltaico*. Se as duas extremidades do “pedaço” de silício

forem conectadas por um fio, haverá uma circulação de elétrons. Esta é a base do funcionamento das células fotovoltaicas.



**Figura 1** - Corte transversal de uma célula fotovoltaica

A eficiência de conversão das células solares é medida pela proporção da radiação solar incidente na superfície da célula que é convertida em energia elétrica. As melhores células apresentam um índice de eficiência de 24%<sup>[2]</sup>.

Este projeto é apresentado com o propósito de criar um sistema de geração de energia elétrica através de módulos solares fotovoltaicos para carregar baterias de uma cadeira de rodas motorizada.

O objetivo é analisar a confiabilidade, a eficiência e os custos para a implantação de tal sistema.

## DESENVOLVIMENTO DO PROJETO

Em uma cadeira de rodas motorizada as baterias precisam ser carregadas durante oito horas para se ter uma autonomia média de 15km. Este projeto tem como finalidade instalar um sistema de geração de energia a partir de módulos solares fotovoltaicos aumentando a autonomia da cadeira e diminuindo o tempo de carregamento das baterias.

A idéia inicial era acoplar o sistema de geração de energia fotovoltaica em uma cadeira de rodas motorizada convencional. Devido ao alto custo, a aquisição de uma cadeira de rodas motorizada para a realização dos testes tornou-se inviável. Sendo assim foi proposto a motorização de uma cadeira de rodas manual.

Para realizar tal motorização foram utilizados dois motores de 24V/50W, duas baterias de 12V/45Ah ligadas em paralelo, um comando de acionamento dos motores (frente/ré), um comando de direção (esquerda/direita) e um velocímetro.



**Figura 2:** Instalação das Baterias e dos Motores em uma Cadeira de Rodas Convencional

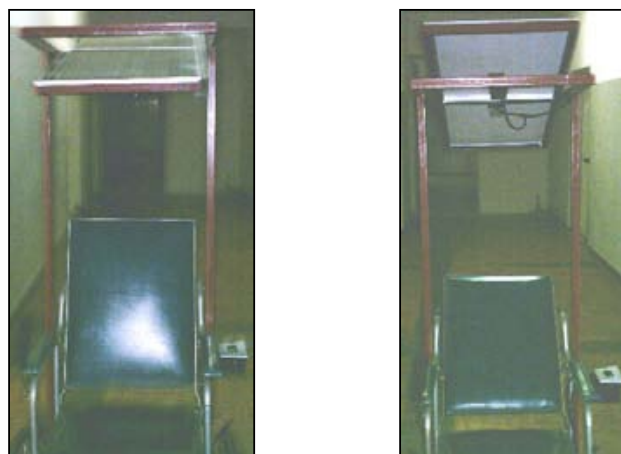
Para instalar o sistema de geração de energia através de módulos fotovoltaicos é preciso dimensionar a potência dos módulos solares e a potência do controlador de carga. Este dimensionamento leva em

consideração a radiação solar da região, os dias sem sol, a especificação dos motores e das baterias, a eficiência dos componentes entre outros fatores.

Foi realizado o dimensionamento e chegou-se a conclusão que seriam usados dois módulos solares de 22W cada um e um controlador de carga de 24V/8A. Cada módulo é capaz de fornecer 6,55Ah por dia, possuindo 55,9cm de comprimento, 40,7cm de largura, 2,5cm de espessura e um peso de 3,2kg. O controlador de carga permite o controle do limite de carga que as baterias podem receber evitando a sua queima por sobrecarga, aumentando o ciclo de vida destas baterias. O Controlador de Carga proporciona uma sensível redução de custos, maior segurança e eficiência no controle de carga das baterias.

Para um maior aproveitamento do sol a montagem da estrutura dos módulos solares possui três posições: horizontal, inclinada para cima ou inclinada para baixo. O usuário pode, ainda, remover a estrutura nos períodos escuros.

Quando o usuário não conseguir carregar as baterias pelo Sistema Fotovoltaico ele poderá carregar do modo convencional (carregador de bateria).



**Figura 3:** Instalação dos Módulos Solares Fotovoltaicos em uma Cadeira de Rodas.

Para analisar os custos para implementar tal sistema foi realizada uma pesquisa minuciosa dos componentes utilizados. Nesta pesquisa foram levados em consideração a garantia, a procedência, o material utilizado e o preço.

A Tabela 1 abaixo nos mostra o preço de cada um dos componentes utilizados. O preço total mostrado não leva em consideração a mão de obra utilizada para montar a estrutura na cadeira de rodas manual.

**Tabela 1 – Preços dos Componentes utilizados e seus respectivos preços**

| Componente                          | Preço Unitário | Preço Total |
|-------------------------------------|----------------|-------------|
| Cadeira de Rodas Manual             | R\$ 330,00     | R\$ 330,00  |
| 2 Baterias Tudor 12V / 45A          | R\$ 165,00     | R\$ 330,00  |
| 1 Motor Elétrico 280W / 24V         | R\$ 160,00     | R\$ 320,00  |
| 2 Módulos Solares Fotovoltaicos 22W | R\$ 470,00     | R\$ 940,00  |
| 1 Controlador de Carga Phocos 8A    | R\$ 80,00      | R\$ 80,00   |
| 1 Velocímetro                       | R\$ 30,00      | R\$ 30,00   |
| 1 Pneu 12 polegadas                 | R\$ 32,00      | R\$ 32,00   |
| 1 Rolamento da Roda                 | R\$ 11,00      | R\$ 11,00   |
| 1 Câmara de Ar                      | R\$ 17,00      | R\$ 17,00   |
| 1 Corrente                          | R\$ 16,00      | R\$ 16,00   |



|                            |            |                         |
|----------------------------|------------|-------------------------|
| 1 Botão Acionador do motor | R\$ 15,00  | R\$ 15,00               |
| 1 Aro de Alumínio          | R\$ 40,00  | R\$ 40,00               |
| 1 Coroa Dentada do Motor   | R\$ 16,00  | R\$ 16,00               |
| 1 Coroa Dentada da Roda    | R\$ 16,00  | R\$ 16,00               |
| Metalon para estrutura     | R\$ 100,00 | R\$ 100,00              |
| <b>PREÇO TOTAL</b>         |            | <b>R\$ R\$ 2.293,00</b> |

Como a mão de obra varia de acordo com o local, aqui foi considerado o número de dias trabalhados para a montagem da estrutura. Para montar toda a estrutura foram necessários quatro dias três dias de trabalho.

Considerando que uma cadeira de rodas motorizada tem um preço médio de R\$ 5.750,00, vê-se uma economia de 60,12% e com a vantagem da cadeira apresentada possuir dois módulos solares fotovoltaicos que vão ajudar o carregamento das baterias e aumentar a autonomia.

Com um usuário de 70kg a cadeira de rodas alcançou uma velocidade média de 2,5 km/h, conseguindo subir rampa, andar para frente e para trás e girar sobre seu próprio eixo. Este projeto se encontra em fase de desenvolvimento e novos testes serão realizados.

## CONCLUSÃO

A principal dificuldade da viabilização de veículos elétricos sempre está associada a baixa autonomia das baterias e ao preço elevado do sistema. Aqui criou-se uma cadeira de rodas motorizada de baixo custo e nela foram acoplados módulos solares fotovoltaicos no intuito de aumentar sua autonomia. Esta cadeira de rodas motorizada teve um custo 60,12% menor do que as cadeiras de rodas motorizadas convencionais tendo a vantagem da geração alternativa de energia no carregamento das baterias.

As energias alternativas vêm crescendo no Brasil, mas para isto é preciso investimento e pesquisa de novos produtos. Com desenvolvimento deste projeto pretende-se mostrar que energias alternativas também são muito bem aplicáveis na geração de energia elétrica em baixas potências.

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## MORPHOLOGY OF THE DIAMOND FILM PRODUCED BY CHEMICAL DEPOSITION OF THE VAPOR PHASE FOR APPLICATIONS IN SADDLE OF MUSICAL INSTRUMENTS OF CORD.

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**Abstract .** *The CVD diamond film deposition was taken above a Silicon Carbide (SiC) sample. This surface was scratch and scouring in order to a good adhesion of the film and was used diamond pasta with until one micron for took off oxides and incrustations in the sample. Was do a cleanness with ultrasound and some analysis about your weight and morphology using a electronic microscope and optical. The diamond film was deposited, above the SiC, using a hot filament reactor with a gas mix of 1,5% of methane in volume and balance of hydrogen . The diamond film produces a big capacity of sound transmittion. This propriety permits the application of this stuff in “rastilhos” (saddle) of cord musical instruments. To analyses the capacity of conduct the sound, was used an acoustic guitar with six strings and a viola with ten strings, yours waves was captured with a Tektronix oscilloscope and transferred to a computer using a RS-232 serial interface. The deposition was produced to present a plan orientation with a smooth and homogeny surface. An electronic microscope was used to observe the film morphology. All the samples present films with a uniform grains, with plan crystals or pyramidal and values above a five microns.*

**Keywords:** *CVD diamond morphology, Carbide Silicon (SiC), Diamond Film, hot filament CVD, Sound Waves.*

## **1. Introduction**

### **1.1 The sound and the CVD Diamond**

Is of knowledge that the diamond is capable of transmit waves with bigger speed, being able to the speed arrive to 18.000 km/s. (Davis, 1993) The diamond application in musicals instruments is somewhat unusual of be carried out, however, on the basis of this estate, we have the intentions of evaluate the possibility of a new line of products, of high performance, destined for the musical application that utilize the estates of the diamond for provide earned and better vantages in the transmission of waves.

In the musicals instruments the sound is produced in consequence of the vibration of a part of the instrument which by some environment is transmitted for our ears. In a acoustic guitar, by an external stimulate, produces vibration of the cords. However, for the sound to be audible and with the tone that characterizes the instrument is necessary that the vibrations of the cords are transmitted for the resonance box of the instrument. That transmission happens by a piece that stayed between the cord and the resonance box, this piece is call of “rastilho” (saddle). Then, the vibrations of the cords are transmitted for the resonance box by a solid environment which influence straightly in the final quality of the sound that the instrument is capable to produce.

The sound is a phenomenon of mechanical nature and because of that need a material for be manifested and spread.

The sonorous waves are produced by deformations provoked by the difference of pressure in any elastic environment (air, metals, isolates, etc), being necessary this environment to spread. In this way, we perceive that the sound is a mechanical wave, not spreading in the vacuum.

In case of the sound transmission by a solid material the waves are transmitted by vibrations, atom by atom, being then straightly related with the forms by the atoms are connected. Then, is easy to conclude that the diamond should be a stuff that present goods estates relatives the waves transmission.

There're many studies being carried out exist as to acoustic waves device with the application in telecommunication industry (Oliner, 1978). However, the acoustic researches of the diamond have limited mainly the application in SAW (device). This project comes for exploit another branch of the acoustic estates of the diamond that is the application in musicals instruments. Studies relating the diamond with stuff piezoelectric has shown promising, by example with devices based on ZnO/polycrystalline diamond/itself layered structures has been reported, where the diamond layers has been grown by hot filament or chemical vapor deposition (CVD). (Nakahata , 1992-1998)

The objective of this paper is present the analysis about the morphology of the diamond film because the capacity of sound transmission is related with the form that the position of diamond grains and your homogeny growth.

## 1.2 Carbide Silicon (SiC)

The silicon carbide is very interesting for high voltage, high frequency and structures that work in high temperatures, due to big saturation of electron that move to high speeds and good thermal conductivity (Dimitrov, 1984; Chowdhury, 2004). Both in his structure microcrystalline as in the polycrystalline present a big range of application, being able to plan for function in contacts of high conductivity in thin technologies of film, structures of heterogeneous stuff, etc.

The silicon carbide (SiC) is a pottery that presents covalence connections what gives him the advantage of be structurally stable in high temperatures. It is utilize like abrasive, by example, in sandpapers.

Outside these characteristics presented, the SiC is a stuff that due to his crystalline structure is going to accept well the deposition of diamond CVD. The adhesion about the SiC substract is very adequate mainly herself the surface of this will be with a good finish.

## 2. Experimental

This experimental part refers to the preparation of the saddles and the wave acquisition, being used an acoustic guitar to it.

### 2.1 Preparation of the SiC substracts

The Carbide of Silicon utilized, was developed in ours own institute by the laboratory of pottery, being the samples utilized for study presented a density of 3,00g/cm<sup>3</sup>.

In this project phase follow the stages:

1. Cut of the samples in the dimension of the "rastilho". This dimension was 80 x 5,5 x 2,25mm (fig. 1).
2. Preparation of the surface with sandpaper 400, 600 and 1500
3. Scouring with diamond paste. This phase is very important for don't have problems during the diamond growing. Was follow this sequence:
  - Scouring with diamond paste of 6 µm
  - Scouring with diamond paste of 3 µm
  - Scouring with diamond paste of 1 µm
4. Cleanliness of the surfaces with ultrasonic wash.



Figure 1: Samples of SiC cut in the dimensions of the guitar saddle.

## 2.2 Deposition of the CVD diamond in the sample of SiC.

The CVD diamond was obtained with a hot filament reactor. The conditions of the film growth was studied parallel, finding the best conditions (temperature, pressure and saturation of gas) for the diamond presents an acceptable growth and morphology.

The conditions of film deposition with 100 sccm of gas mixture, with 2% of methane in a temperature of 800 °C, with 50 Torr provide the film with better homogeneity regarding the size of grain in the surface. In the fig. 2 is possible to observe a picture carried out by MEV of the CVD diamond film in the surface of the sample.

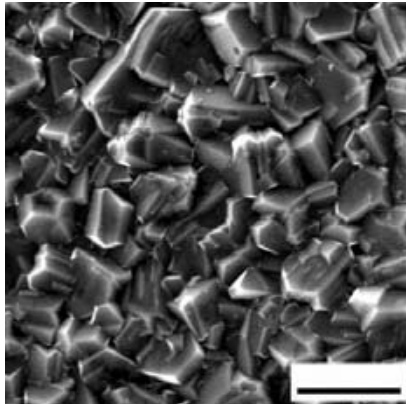


Figure 2: Picture of diamond CVD take with MEV, with enlargement of 5000x.

## 3.3 Waves acquisition:

At first was used a pickup in the guitar body. This pickup was connected with a Oscilloscope and the waves obtained was very irregular with a lot of noises.

On the fig. 3 is a sample of this wave, where is possible to observe that exist many different waves group.

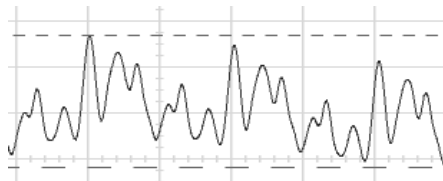


Figure 3: Acquisition of waves without a filter.

For solve this problem, is necessary use a wave filter, which select only the fundamental wave to be viewed.

At the figure 4 is present a wave that has obtained with a filter. On the wave is possible to observe only one wave with a specific characteristic. In the fig. 3 there is a complex of individual waves that form this wave that don't is a sinusoidal form. This wave form difficult the analyses that will be realize.

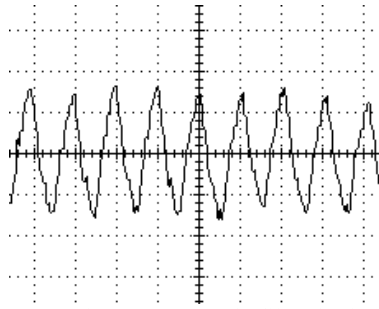


Figure 4: Acquisition of waves using an electronic filter for isolate the fundamental wave.

#### 4. Conclusion

The SiC is a stuff that adapts to the capacity of promote the growth of CVD diamond and a great adhesion of the even, being like this, its application as “rastilho” of cord instrument a big possibility of success for the given ends of improvement in the transmission of the sound. The conditions of film deposition with 100 sccm of gas mixture, with 2% of methane in a temperature of 800 °C, with 50 Torr provide the film with better homogeneity regarding the size of grain in the surface.

The first wave’s acquisition shows a way that the sound study can be realized. A preliminary study that isn’t present in this paper, has showed that this new material can improve the sound characteristics of the musical instruments.

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