Preparation of the Jaws Damaged Parts from Composite Biopolymers Materials

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Abstract

Composite materials composing of fusing two materials or more are disaccorded in mechanical and physical characteristics, The studied the effect of changing in the reinforcement percentage by Hydroxyapatite Prepared nano world via the size of the nanoscale powder manufacturing manner chemical precipitation and microwave powders were two types their preparations have been from natural sources: the first type of eggshells and the other from the bones of fish in mechanical Properties which include the tensile strength, elastic modulus, elongation, hardness and tear for composite material consisting of Silicone rubber (SIR) reinforced by (μ-n-HA), after strengthening silicone rubber Protect proportions (5,10,15,20 wt%) of Article achieved results that increase the additive lead to increased hardness while tougher and modulus of elasticity decreases with added as shown in the diagrams.

Key Words: composite materials, Jaws defect, Biopolymer, Hydroxyapatite.

الخلاصة

المواد المتراكبة تتكون من خلط مادتين او كثر وتكون مختلفة في الخواص الميكانيكية والفيزيائية , تم دراسة تأثير اضافة هيدروكسي ابتايت كمادة مقواة محضرة بحجم نانوي مايكروي تم تصنيع المسحوق النانوي بطريقة الترسيب الكيميائي والمساحيق المايكروية كانت بنوعين تم تصنيعهما من مصادر طبيعية : النوع الاول من قشور البيض والاخر من عظام الاسماك. على الخصائص الميكانيكية التي تتضمن مقاومة الشد, معامل المرونة, الاستطالة, الصلادة والتمزق للمادة المتراكبة التي تتكون من مطاط السيليكون مدعمة بـ(مايكرو – نانو) هيدروكسي ابتايت, بعد تدعيم مطاط السيليكون بنسب تحميل (5,10,15,20 wt%) من المادة حقق النتائج ان زيادة المادة المضافة تؤدي الى زيادة الصلادة بينما اشد ومعامل المرونة تقل مع الاضافة كما موضح في المخططات.

الكلمات المفتاحية: المواد المتراكبة, عيوب الفكين, بايوبوليمر , هيدروكسي بتايت.

Introduction

In recent years, there has been an increasing emphasis on materials applications in biomedical areas. However, the term "biomaterials" may have encountered different interpretations both in materials science and clinical medicine. Here we define a biomaterial as a synthetic material used to replace part of a living system or to function in intimate contact with living tissue. A biomaterial is different from a biological material, such as bone, that is produced by a biological system. Biomaterials can be categorized into different types in terms of their structural, chemical, and biological characteristics. For example, as in ceramics, glasses, and polymers with a varied degree of bioactivity [ShiDonglu., 2006].

The study of the mechanical properties of materials Engineering is one of the very important things that must be Taken into consideration because they define the behavior of these materials under influence of stress applying on it [Marc Andrew Megers 1999] and Under the influence of various external conditions as Pressure, temperature , time of stress Damocles , The speed of the stress , the nature of chemical solvents And other factors that affect a lot on the mechanical properties of the polymer matrix composite materials, the study of Mechanical properties is very complex because of many Variables that affect each property [Brain Mitchell 2004, Lucas Kumosa, *et al.,* 2005]. Composite materials consist of two or more materials with different specifications associated with each In a certain way to give a compositions and be better than the characteristics of the properties materials included in the composition if they are used Individually**, [**Deborah, 2010; Callister 2003], rainforcment material may be particles or fibers or sheets etc, [Christophe Baley *et al.*, 2006; Chawla 1987, Higgins 2006].

Matrix materials

Silicon Rubber

A polymer is widely used in the fabrication of artificial external body parts, because of its good properties, biocompatibility and biodurability. It is easy to manipulate with adequate working time and good color stability. Its physical properties of relevance include hardness, high tear resistance and reliable bonding to acrylic substructures which are frequently used along with them [Zubeda, 2011]**.** It was obtained from an initial materials company Shem Zen and purity of 100%

Hydroxyapatite

One of the most extensively studied bioactive ceramics is hydroxyapatite. HA is chemically similar to the mineral component of bone and other hard tissue in mammals. It is composed of the same ions that construct the mineral part of teeth and bones. It shows excellent biocompatibility not only with hard tissues, but also with soft tissues, such as skin and muscle. Moreover, it is bioactive, and promotes osseointegration when directly implanted into bone [ShiDonglu., 2006]. Hydroxyapatite is a naturally occurring mineral form of calcium apatite with the formula $Ca_{10}(PO_4)_6(OH)_2$. the results of chemical analysis of the HA using a technique (XRD).

Experimental work

Mechanical Properties

Tensile Strength: This is defined as the force per unit of original cross-sectional area which is applied at the time of rupture of the dumbbell test specimen. It is calculated by dividing breaking force in Newtons by the cross-section of unstressed specimen in square meters the samples were prepared by cutting uncured compound sheet to give a test piece of constant volume.

Modulus: The term modulus, or stress, is used to express the amount of pull in Newton per square meter required to stretch the test piece to a given elongation. It expresses resistance to extension, or stiffness in the vulcanized rubber.

Once again, in the common parlance of rubber technology the stress required for a given elongation is used to represent the material stiffness. This quantity is called the modulus. A 300% modulus, for example, means the stress required to produce a 300% elongation. In mechanical engineering usage, however, the term *modulus* is defined as the ratio of stress to strain. If this ratio is constant the material is said to obey Hook's law and the constant is called *Young's modulus* or *modulus of elasticity*. In practice, the term *Young's modulus* is often used to represent the ratio of stress to strain even in situations where it may vary with change in elongation [Wise 1973].

Elongation: The term elongation is used to describe the ability of rubber to stretch without breaking. To describe this property as measurement, it is more accurate to refer to it as “ultimate elongation”, since its value, expressed as percent of the original length, is taken at the moment of the rupture [Saltman 1973].

Tensile strength and elongation properties serve as an index to the general quality of a rubber compound. Rubber compound less than 6.9 MPa in tensile strength are usually poor in most mechanical properties and those with tensile strength over 15.7 MPa are usually good in most mechanical properties [ASTM 1985].The above three tests were carried out by using Monsanto T10 Tensometer equipment and according to ASTM-D412 [Thomas, 2010].

Hadness:Typically defined as resistance to indentation under specific conditions This test is conducted on rubbers in accordance with ASTM D2240-75, D1415-68, and D531-78 [Galimberti , 2011]

Tear resistance (or tear strength) :is resistance to the growth of a cut or nick in a vulcanized (cured) rubber specimen when tension is applied ,this test was carried out by using Monsanto T10 Tensometer equipment and according to ASTM-D412 [Thomas, 2010]

Abrasion This property in rubber may be defined as the resistance to wearing away by rubbing or impact in service, this test was carried out in accordance with British standard B.S 903 PTA-9 by using Akron Abrader. [Thomas , 2010].

Result and Discussion

XRD results

XRD result of egg shell-HA powder

Fig (1) shows XRD analysis of the hydroxyapatite which is prepared from egg shells powder in the range of 10º to 50º diffracted angle. The pattern refers to the existence peaks of HA phase $Ca_{10}(PO_4)_6(OH)_2$,thereby, proved the success of egg shells process in producing the required HA powder.

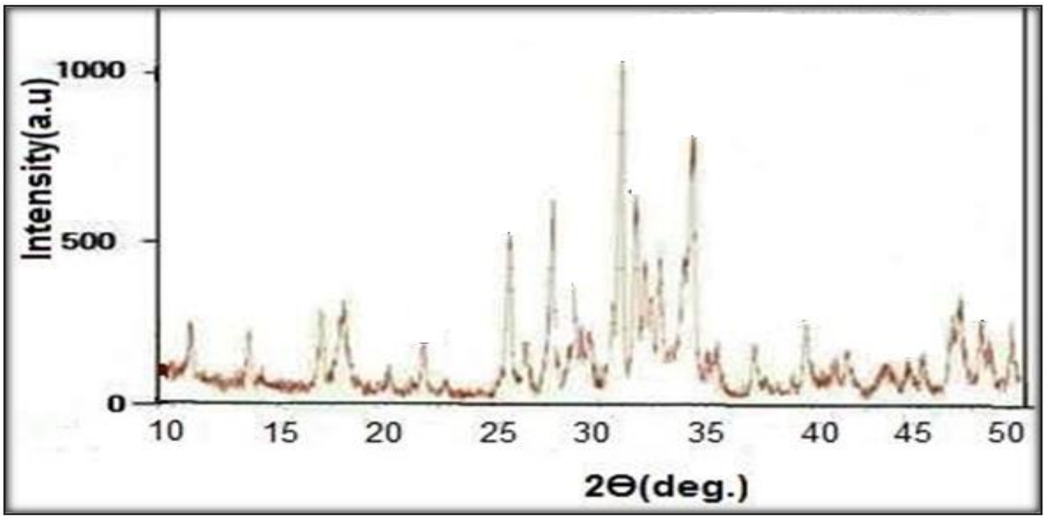

Fig. (1) XRD patterns of egg shell powder- HA powder.

XRD result of fish bones-HA powder

The XRD patterns of fish bones powder diffracted at the range angle 10º to 50º is shown in fig.(2). The patterns showed that all peaks were pure HA after matching with standard XRD card NO.(09-0432). These results proved the success of fish bones method in producing pure HA powder.

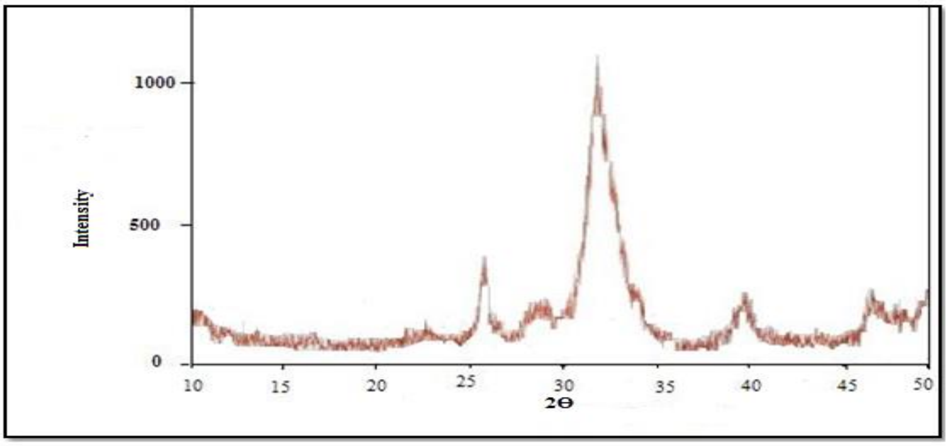

Fig.(2) XRD pattern of fish bones-HA powder.

XRD result of nano HA powder

Fig.(3) shows the XRD patterns of nano powder of HA powder that chemically precipitated and diffracted at angle 10º to 50º. The patterns showed that all peaks were pure hexagonal Hydroxyapatite $Ca_{10} (PO_4)_6(OH)_2$ after comparison with the standard XRD card. These results can be attributed to successful manufacturing of the nano HA powder high purity by the chemical precipitation.

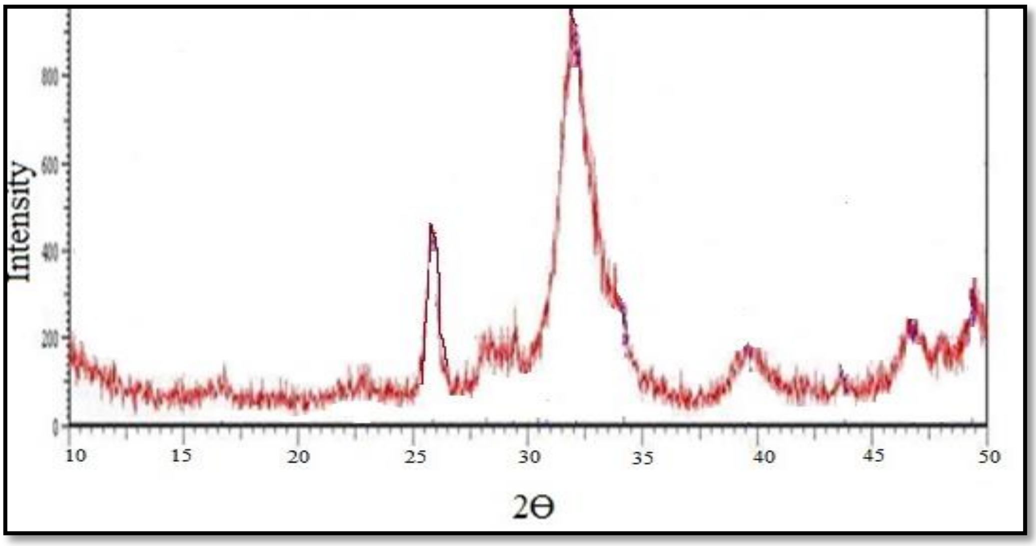

Fig.(3) XRD patterns of nano (HA) powder.

As appears in figures (4,5,6,7):

When additions augment the tensile strength; modulus; tear resistance and elongation decrease, owing of augment cross-link between rubber and filler and this results from the small particle size of the fillers n-HA that mean large surface area can interact with rubber fobs. and this agrees mentally with [Al Zubaidy, 2007]

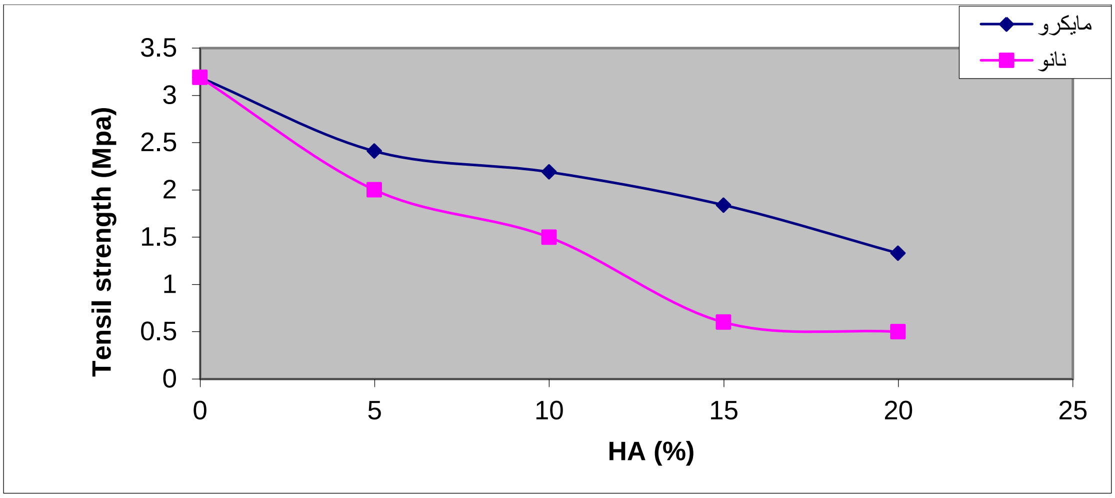

Fig (4) Impact of addition Hydroxyapatite on **Tensile Strength**

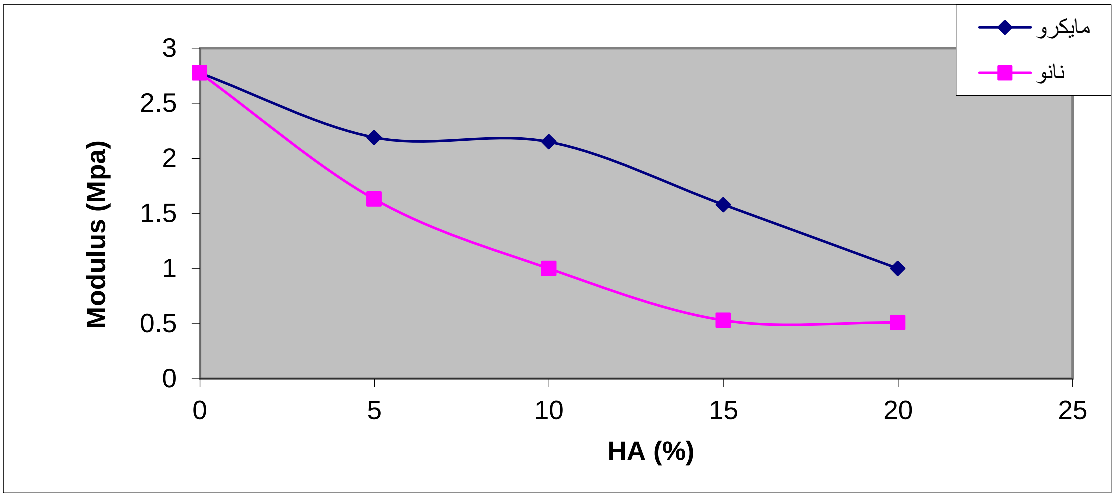

Fig (5) Impact of addition Hydroxyapatite on **Modulus**

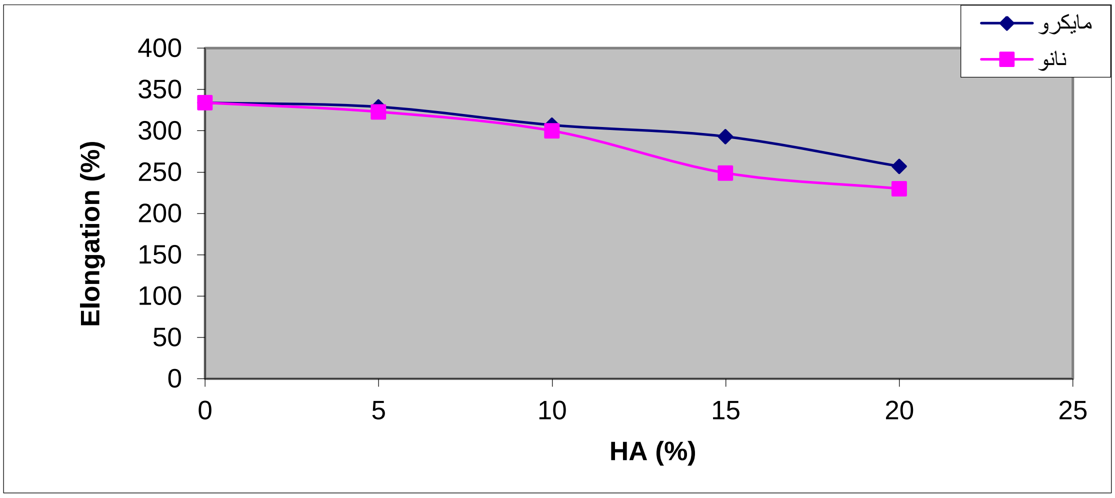

Fig (6) Impact of addition Hydroxyapatite on **elongation**

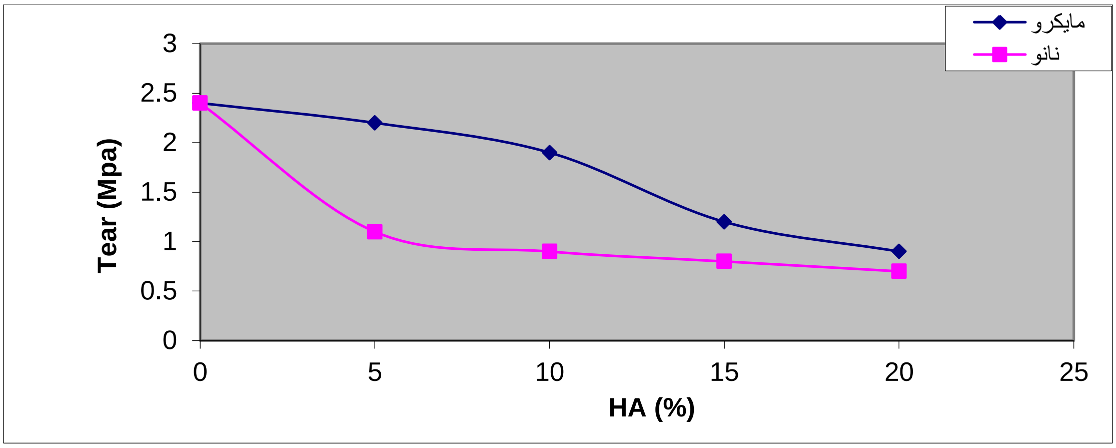

Fig (7) Impact of addition Hydroxyapatite on **Tear resistance.**

As appears in fig (8) : as addition augments ; hardness augments owing of the interacting between additions n-HA and rubber fobs that lead to increasing the ability of Penetration resistance and this agrees mentally with [Oday Hatem Raheemah Al-bodiry 2013].

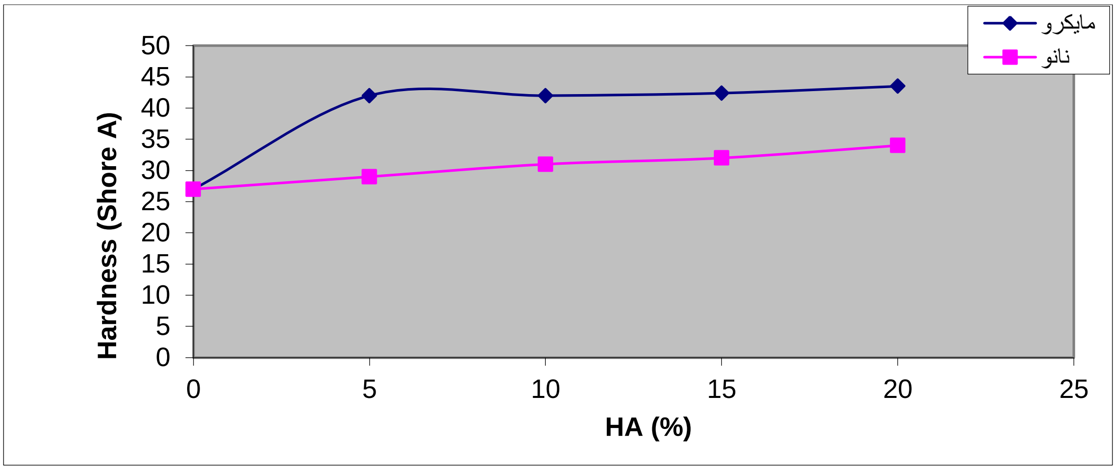

Fig (8) Impact of addition Hydroxyapatite on **Hardness**

Conclusion

(1) The augment of additions ratios of n-HA leads to decrease the Tensile Strength ; Elongation; Tear Resistance and Modulus.

(2) The increase of additions ratios of n-HA leads to augment the Hardness.

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