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Research Article

Studying the Effect of Titania Additions on some properties of Porcelain

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Abstract

The paper presents the production of porcelain for the ceramic by inexpensive natural raw materials, the principal raw materials of porcelain composition was selected consisting of 50% kaolin, 25% feldspar, 25% silica, the sample synthesized were characterize by X-ray diffraction (XRD) technique, than study the effect additives at different concentration form titanium oxide (TiO_2)at (2, 5, 10, 15, 20) wt% on some physical and dielectric properties of porcelain.
The samples are prepared by the conventional manufacturing method.
The physical and dielectric properties of porcelain show that change considerably with the substituent sample. It was found that the increase of the titanium oxide (TiO_2) additives of all our sample produce increasing in dielectric constant and bulk density, while decreasing with open porosity and dielectric loss tangent.

Keyword: porcelain, feldspar,TiO_2 , dielectric constant, dielectric loss tangent.

الخلاصة

في هذه الدراسة تم تحضير البورسلين بأستخدام تركيبة مكونة من مواد اولية طبيعية وغير مكلفة (50% كاوؤلين – 25% فلسبار – 25% سيليكا). اضافة الى ذلك تم دراسة تأثيرنسب مختلفة من اضافات التيتانيا (2, 5, 10, 15, 20 wt%)على بعض الخصائص الفيزيائية والعزلية للبورسلين المحضر.
حضرت النماذج بطريقة التصنيع التقليدية, حيث لوحظ ان تغير ثابت العزل والكثافة مع تراكيز التيتانيا المضافة بأنها تزداد مع زيادة تراكيز التيتانيا, اما بالنسبة الى ظل زاوية الفقدان و المسامية حيث وجد بأنها تتناقص مع زيادة تراكيز التيتانيا المضافة.

Introduction

One of the product materials madding by heat treatment is the ceramic. It is treatment of substance or mixture of non-metallic substance and inorganic metal material [1]. The producer of ceramic hardness is the porcelain, the porcelain make the ceramic white, intensive impermeable, and semitransparent to liquid that means the porcelain is good mixture of composite materials composing mainly of feldspar, caoling and silica materials raw, porcelain have many good characteristic features that means loads, chemical influence and resistance to mechanical stresses which exposing then beside satiable electric resistance [2].
Oxide of metal titanium TiO_2 is occurring naturally in several types of many mineral sands and rocks The titanium was the ninth common element in the crust earth [3] [4] [5] [6] [7] [8]. Masrtennikove G. M etal [4] had been studied the effect of addition of TiO_2 on fired properties of porcelain material reparation, they founded that four classes of addition normally used for porcelain, however the first kinds is including ,addition that controlling the coagulation thixotroics structure of porcelain suspension on the other hand it control of transition to condensation structure.
The second kind refers that additives which enhancing the sintering process and helping the transformation condense structure to the crystalline structure and the crystalline pseudo coagulation structure, the other kinds is including additive which enhancement the crystal structure of the new forms, the advantage and possibility of using the waste glass as fluxing in poscelaintiles without deterioration in mechanical properties had been investigation by Baker [5], Baker find

that the addition of waste glass enhance consequently and vitirification some surface and mechanical properties.

Materials and Methods

In this paper, we can prepare the porcelain material using elementary material, low cost and foundation of nature freely (50% kaolin, 25% feldspar, 25% silica). These materials are maxing by this ratio and mixture stay at 24 hours. After mixing the sample of this material are presuing (7 ton) to result a bulk of materials.

Since, that bulk of material input furnace $\mathbf{5}\frac{℃}{min}$ (electric furnace) at 1300℃ for three hours and colling ($\mathbf{5}\frac{℃}{min}$) this mixture to room temperature and made a powder to study the effect of X – Ray diffraction. The rangs of angle 2Ɵ are (5 – 80 degrees).

In this papere, we study and evaluated the inters atomic spacing (d), Millar indices (hkl).

However we added the Titiania (2, 5, 10, 15, 20 wt%) to the porcelain and the material mixing with each other for 10 hours by circumference 1.5 cm and width 0.7 and sintering this sample in oven with 1300℃ for 4 hours at air.

The density and porosity of sample have been studied by using Archimedes with water as the immersion medium and we measurement the dielectric constant using LCR meter range (50 HZ to 1 MHz).

Results and Discussion

X – Ray diffraction analysis Figure (1) show that the pattern of X- ray diffraction for porcelain that producing by traditional method from traditional materials.

Philips X-ray diffraction meter was using to tasting this samples. All six samples was transtation at rang angle 2Ɵ from (10-80) degrees with spectroscopic velocity (10 deg/min) estimation all modes that to fulfulment evaluation. the inter atomic spacing c and miller indices (hkl).

Bulk density and open porosity: data in Figure 2 and 3 show that, variation in open porosity and bulk density with amount of TiO_2 addition that's added at sintering (1300℃),

We can show the property improvement due to additive incorporation that view in the curve Figures 5 to 6.

Table 1: X-ray diffraction data of porcelain.

$2\theta(degrees)$	d (A°)	hkl
21.15	4.19	100
26.58	3.34	101
26.96	3.3	006
33.45	2.6	116
35.39	2.52	300
39.71	2.26	161
40.57	2.22	111
41.07	2.19	200
42.70	2.11	223
50.36	1.81	003
55.12	1.60	103
60.14	1.53	211
60.85	1.13	113

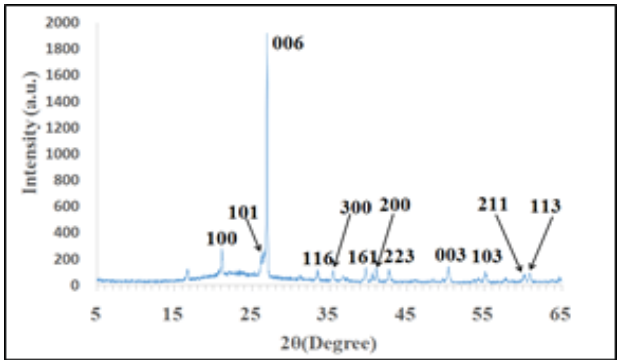

Figure 1: X-ray diffraction of composition (kaolin, feldspar, silica).

It was evident that high reduction in porosity founded when the porcelain sample which was due that the mass transport occurred as a results of glass phase formation.

The phase of glass formed enters in the pores presented in the compact and fills, due to these spherical pores were forming and also the compact gets dandified.

The two Figures (4, 5) show that the variation of dielectric constant and dielectric loss tangent as a function of TiO_2 that addition (Wt %) for porcelain.

Figures (4, 5 show that the dielectric constant value was increased when compared dielectric loss tangent with increasing TiO2 additive (wt %). It may be due to the presence of some micrograms in the ceramic insulators when these crakes wave observing mainly near the quartz particles and those regions of the cry stalling phase was absent [6].

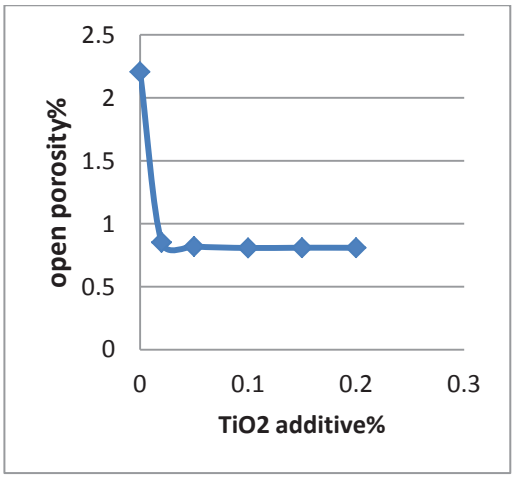

Figure 2: Porosity of porcelain with TiO_2 additives.

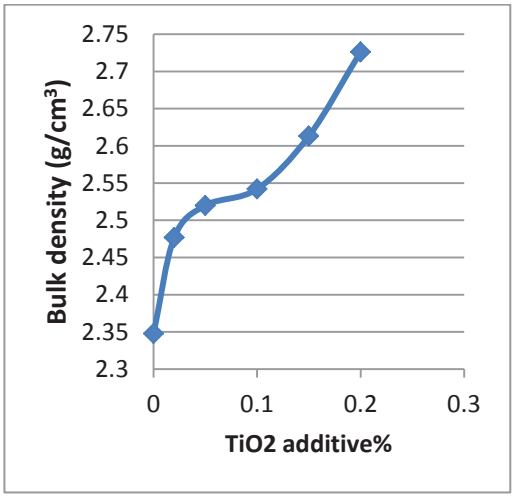

Figure 3: Density of porcelain with TiO_2 additives.

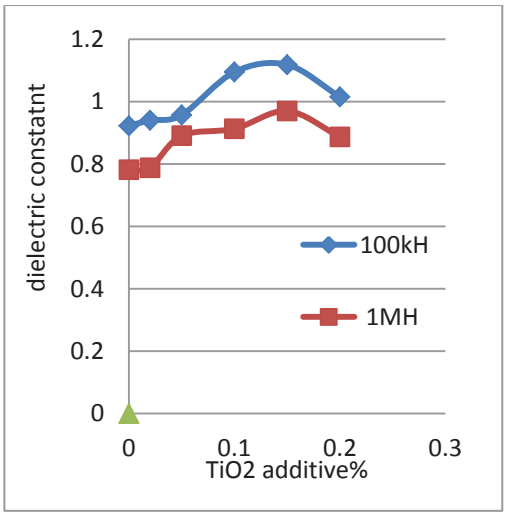

Figure 4: Dielectric constant of porcelain with TiO_2 additives at (1MHz) and (100 KHz).

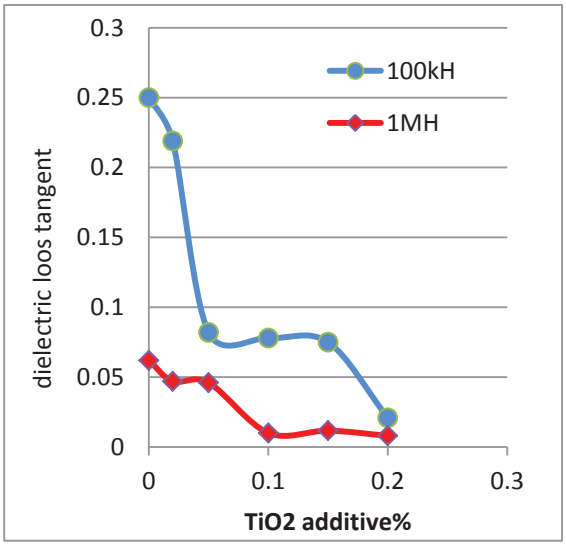

Figure 5: Dielectric loss tanget of porcelain with TiO_2 additives at (1MHz) and (100 KHz).

Conclusions

The experimental results obtained show that local raw materials are quite suitable for porcelain can be produced. The presence of TiO_2 additives (Wt %) in porcelain increased the bulk density and dielectric constant, while the open porosity and dielectric loss tangent to decreasing value.

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