



Auxiliary properties of thermally outlined permeable silicon particles

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The comes about of considering the regularities of arrangement and considering the morphology and composition of permeable silicon particles gotten by the strategy of magnesium warm diminishment of silicon dioxide, made from tests of different sorts of silicon-containing plant crude materials, at a temperature of 650 °C in an argon environment are displayed.

Keywords: Silicon dioxide; Magnesium warm decrease; Permeable silicon.

1. INTRODUCTION

Permeable silicon (PS) is one of the foremost effectively considered nanomaterials, the structure of which is silicon locales entered by a created organize of pore channels [1]. Most frequently, PS is shaped by electrochemical anodization of single-crystal silicon in arrangements based on hydrofluoric corrosive [2]. Personal computer (PC) has numerous properties that are strange of bulk silicon. In specific, it can carry on as a direct-gap semiconductor, illustrating strongly photoluminescence, which is due to quantum impacts emerging in nanosized components of the silicon skeleton [3]. The utilize of a PC makes it conceivable to fathom the issue of making light radiating diodes coordinates with other electronic gadgets on a silicon substrate. A similarly extraordinary highlight of PC is that, being a fabric of non-biological root, it is able to associated with a natural framework, i.e., not at all like single-crystal silicon, it may be a biocompatible fabric. This, combined with its biodegradability and tall adsorption properties, is utilized in biomedicine for supplement and sedate conveyance [4].

The biomedical application of PC requires the improvement of such an innovation for the generation of huge volumes of this fabric, which would be recognized by its economy and straightforwardness. Electrochemical anodizing does not meet these necessities, since the taken a toll of silicon wafers is tall sufficient to guarantee the productivity of generation. To illuminate this issue, considers are being carried

out on the arrangement of PS by the diminishment of silicon oxide confined from plants [5,6]. Numerous plants have a tall silicon substance due to the assimilation of a fluid containing silicic acids from the soil. The foremost promising for inquire about in this region are objects that give expansive volumes of silicon-containing crude materials, such as fast-growing plants, agrarian squander, or plants adjusted to acidic soil conditions, which, in specific, are common in Belarus. All of the over decides the pertinence of investigate related to the arrangement and consider of the properties of nanostructured PC, made by handling silicon-containing plants.

2. INVESTIGATION OF SILICON OXIDE DIMINISHMENT STRATEGIES

Generation [7]. In any case, this strategy is related with long-term utilize of high-temperature administrations (more than 2000 °C) and, appropriately, amazingly tall vitality costs. Too, the tall temperature of the method leads to sintering of silicon, which does not permit the arrangement of a permeable structure. In expansion, a by-product of such generation is carbon dioxide, which is dependable for the undesirable nursery impact.

A really alluring strategy from the point of see of biology, based on the utilize of sun-oriented vitality, is proposed in [8]. In any case, this process is time expending and so wasteful. Moreover, known could be a method of decreasing silicon oxide with dynamic metals, in specific aluminum or magnesium. At the same time, the method temperature is decreased by a few times compared to carbon decrease innovation. In any case, within the case of aluminum, the by-product may be a chemically steady alumina. This leads to challenges in cleaning the gotten silicon structures.

As of late, there has been an increment within the number of ponders on the lessening of silicon oxide with magnesium [9]. As the beginning fabric, silicon oxide powders synthesized from green growth, bamboo, rice husk, horsetail, and the like are utilized. The temperature administrations in this case shift inside 630–650 °C. It ought to be famous that, at temperatures over 535°C, fractional sintering of PS is watched; subsequently, the rummage around for ways to avoid this impact is still underway. PK particles delivered in this way are recognized by an assortment of morphological forms, their properties are being effectively considered for utilize within the zones of verbal conveyance of supplements and drugs, makeup, orthopedics, and tissue building. The plausibility of creating coatings containing PC particles with drugs for cleansing and recuperating of open wounds is being considered [10]. It is amazingly imperative in this case to control the substance of the sedate within the coating and the pH level of the harmed surface, which has diverse values for sound and ailing tissue. PC particles inserted within the coating can play the part of not as it is medicated carriers, but moreover particular locators due to their special optical properties. In any case, there are still no distributed works on the think about of the ghastly affectability of organic PC in different ranges of electromagnetic radiation. As of late, the comes about of considers of the adsorption of manufactured sebum impersonation by natural PC have been displayed, which illustrated the guarantee of utilizing this fabric in biomedicine and beauty care products as a body powder [11]. One of the necessities for such a powder on the portion of restorative companies is the exhibit of photoluminescence within the unmistakable extend of electromagnetic radiation, which has not however been examined for tests of natural PC [14]. In this way, the ponder of regularities and optimization of the modes of lessening of natural silicon oxide with magnesium, as well as the think about of the auxiliary and optical properties of the nanostructured PC shaped in this case, stay open issues.

3. MATERIAL AND METHODS

To create PC particles, silicon dioxide powder based on Rice Silk rice husk, Bamboo Silk bamboo husk, and Tabasheer bamboo internodes (fabricated by Soliance, France) is utilized. Powders of silicon dioxide of vegetable root are blended with powders of magnesium and sodium chloride in a proportion of

1:2.5:10 and put in ceramic vessels for consequent warm treatment. The components of the blend are weighed employing a Sartorius-CP225D exactness adjust, giving an exactness of up to 0.01 mg. Sodium chloride is included as a buffer fabric anticipating the sintering of silicon nanocrystals, which made it conceivable to guarantee the nearness of a huge number of pores within the powder particles. The ceramic watercraft is introduced in a quartz tube, in which an air of an inactive gas (argon) is made [12].

The tube is set in a Carbolite HST 1200/600 tube heater. Warm treatment in a stove is carried out at a temperature of 650°C for 6–7 h. After warm treatment, the powder tests are blended with refined water until a suspension is shaped, to which concentrated hydrochloric corrosive is steadily included. Blending with water is carried out in arrange to break down the sodium chloride contained within the warm treatment items. Hydrochloric corrosive is utilized to carve out the magnesium oxide. The tests are kept in a hydrochloric corrosive arrangement for 4–8 h. An attractive stirrer is utilized to consistently associated the reagents and evacuate gas bubbles. After that, from three to five cycles of washing powder tests in refined water, their filtration and drying in discuss at room temperature are carried out [13].

The morphology of the powders is examined utilizing checking electron microscopy (SEM) on a Hitachi S-4800 hardware (made in Japan). This magnifying instrument show gives amplification up to 300 - 500 thousand times and a determination of 1 nm. The basic composition of the powders is decided on an Interface Expository AN 10000 energy-dispersive X-ray range analyzer (EDS) (USA) built into a Cambridge Disobedient Stereoscan-360 electron magnifying lens (UK). The stage composition of the tests is examined by X-ray diffractometry. The spectra are taken on a DRON-3 device (made in Russia). Amid the investigation, $K\alpha$ radiation from a copper anode with a wavelength of $\lambda = 0.15406$ nm is utilized. The voltage and anode current are 30 kV and 20 A, individually [14-17].

4. RESULTS AND DISCUSSION

The method of warm lessening of silicon in a blend of silicon oxide and magnesium powders continues concurring to the taking after chemical response:



On Figure 1 appears a plot for carrying out this process, which comprises within the reality that biogenic silicon oxide is blended with magnesium and kept at a temperature of around 650 °C in a vacuum or an inactive gas environment for 7 hours. This leads to the arrangement of a silicon/magnesium oxide nanocomposite, which at that point washed in hydrochloric corrosive, which breaks up magnesium oxide. As a result, a powder comprising of PC particles remains. In this work, NaCl powder is included to the starting response blend, which prevented silicon sintering amid heat treatment, in this manner giving the next porosity of the ultimate fabric.

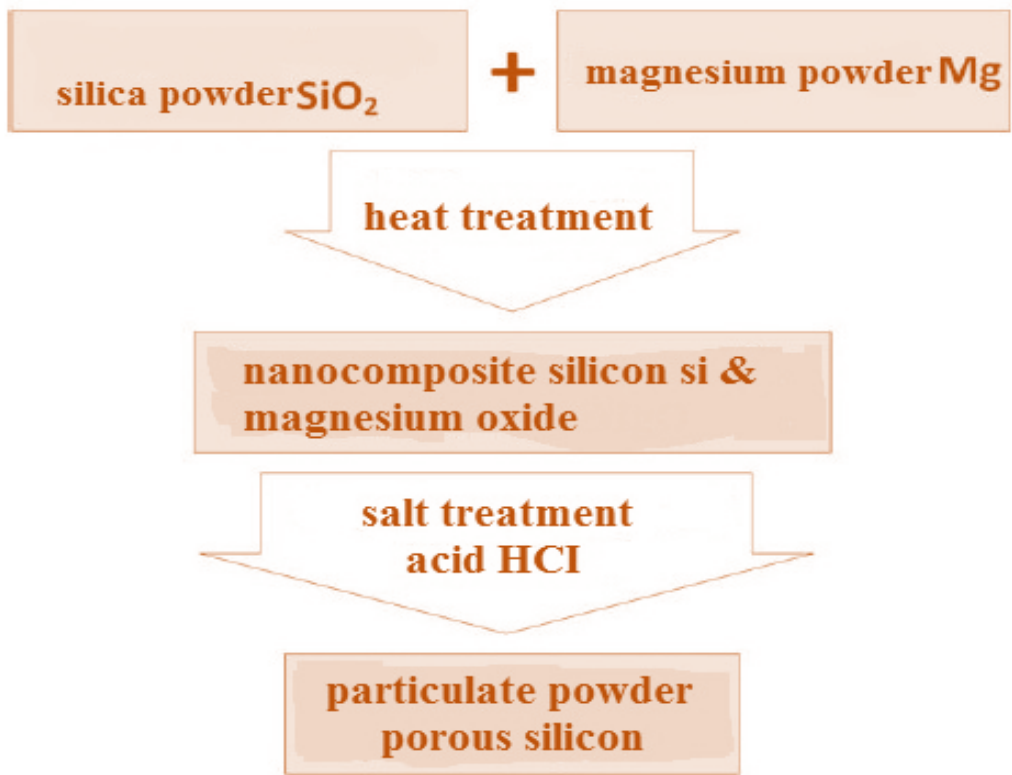


Figure 1 Conspire of the method of arrangement of powder of permeable silicon particles by the strategy of warm lessening.

To ponder the auxiliary properties of the gotten powders, their complex examination is carried out utilizing different strategies for deciding the stage and essential compositions, as well as surface morphology. On Figure 2 appears diffraction designs gotten as a result of X-ray diffraction investigation of powders made by magnesium-thermal decrease of silicon oxide. It can be concluded that all powders are polycrystalline in nature and comprise of silicon crystallites. The powder based on rice husk contains silicon crystallites with a hexagonal and cubic precious stone cross section. At the same time, reflections comparing as it are to the cubic precious stone grid of silicon are watched in bamboo-based powders. A wide band with moo concentrated in all diffraction designs within the locale $2\Theta = 20-25$ degrees show a slight oxidation of silicon crystallites.

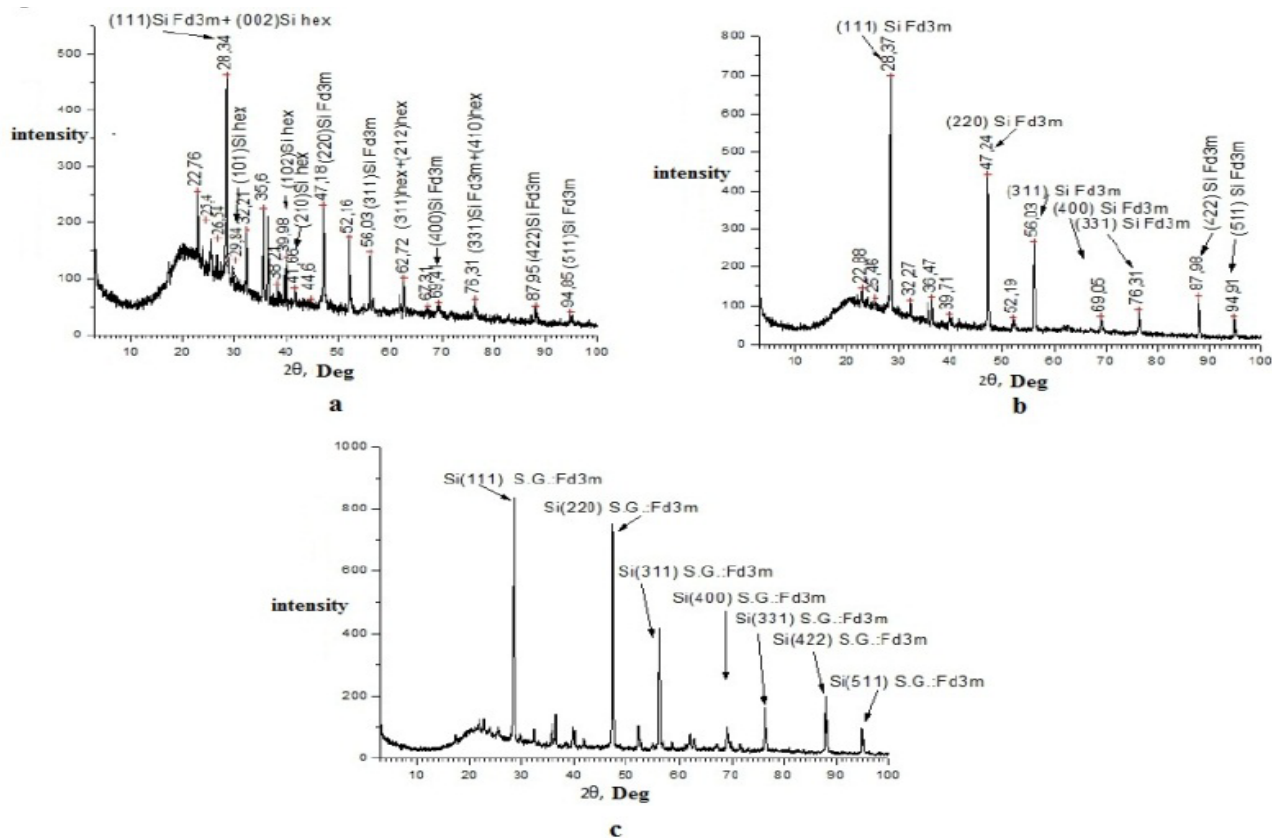


Figure 2 X-ray diffraction designs gotten as a result of X-ray diffraction examination of powders made by the strategy of magnesium warm lessening of silicon dioxide based on (a) rice husk, (b) bamboo internodes, and (c) bamboo husk.

The comes about of X-ray diffractometry displayed over give data on the stage composition of the powders. Be that as it may, X-ray diffractometry cannot distinguish molecules of substances that are not organized into a precious stone cross section. In arrange to decide the nearness of other components within the coming about powders, an EDS investigation is carried out, which allows one to set up the essential composition of the considered materials, i.e., decide their nuclear immaculateness. An electron pillar with a distance across of approximately 1 μm at a vitality of 20 keV given an investigation profundity of 1.3–1.5 μm. On Figure 3 appears EMF spectra normal of powders based on materials from rice and bamboo crude materials. It can be seen that all powders are characterized by the overwhelming substance of silicon and oxygen particles. The spectra moreover appear powerless reflections of magnesium, sodium, and chlorine. The nearness of magnesium can be due to two reasons. To begin with, amid the warm decrease response, magnesium did not totally respond with silicon oxide. Moment, amid ensuing washing of the nanocomposite in hydrochloric corrosive, magnesium oxide is not in part broken up. A critical oxygen substance is to a great extent related with the oxidation of silicon nanocrystals.

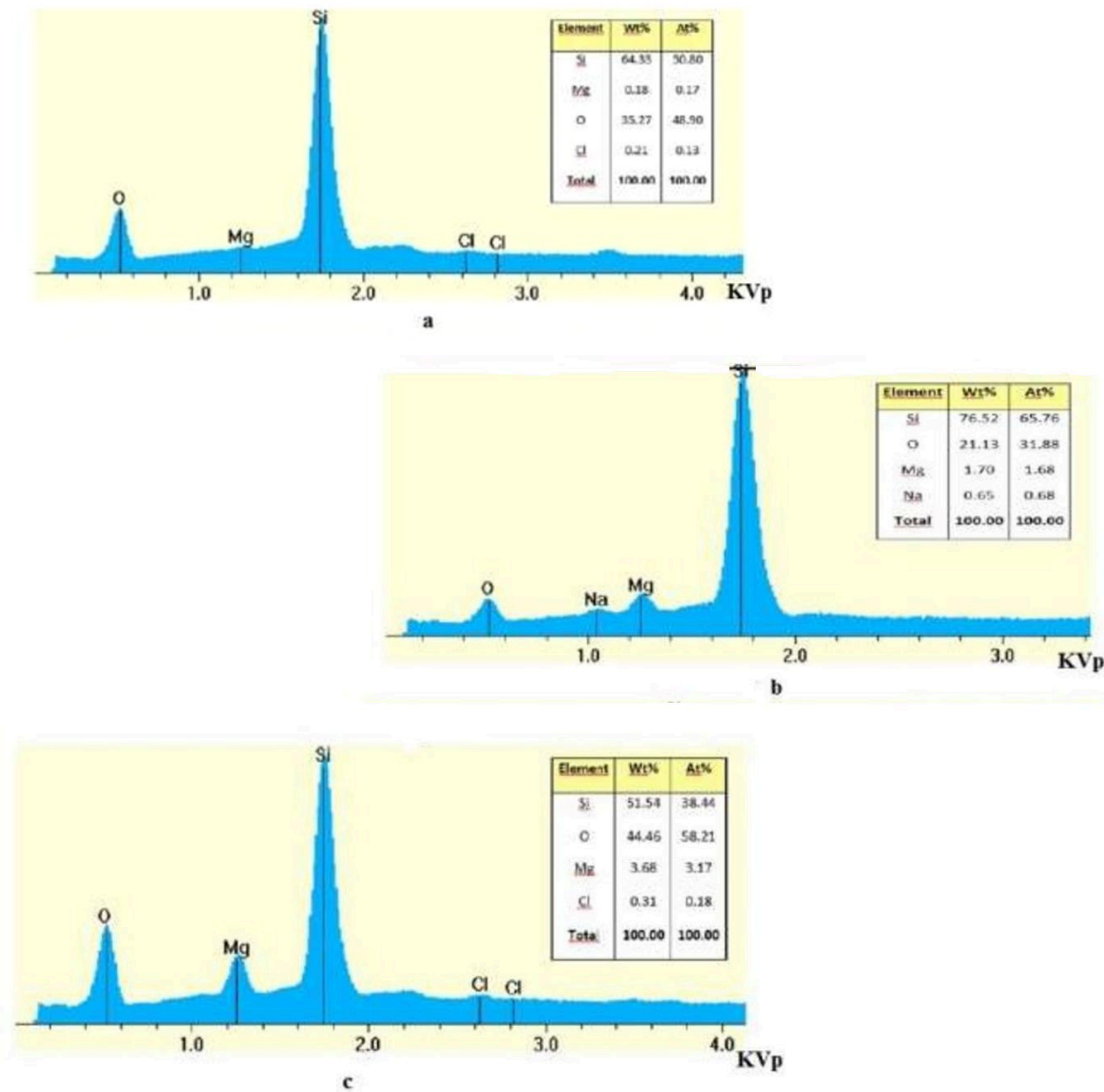


Figure 3 EMF spectra of powders prepared by magnesium-thermal reduction of silicon dioxide based on (a) rice husk, (b) bamboo interstices, and (c) bamboo husk. The data on the content of elements in weight and atomic percent are presented.

5. INFORMATION ON THE SUBSTANCE OF COMPONENTS

It ought to be famous that the most elevated rate of silicon iotas (65.76%) is ordinary for the test based on bamboo husk, and the most reduced (38.44%) is for the powder made utilizing silicon dioxide from bamboo internodes. This is often due to the truth that the first silicon dioxide based on bamboo interstices is a powder, the molecule measure of which is much bigger than the molecule estimates of powders made from plant crude fabric husks. Thus, the particular surface zone of SiO₂ particles from bamboo interstices is not expansive sufficient to guarantee the interaction between the reagents adequate for total diminishment.

Scanning Electron Microscope (SEM) investigation is utilized to ponder the morphology of the test tests. On Figure. 4 appears SEM photos of the surface of powder particles gotten by magnesium warm diminishment of biogenic silicon dioxide. It can be seen that the gotten powders comprise of particles entered by a arrange of pores with sizes that change in extend from 10 to 1000 nm. Comparing the information of SEM, X-ray diffraction investigation and EMF, ready to conclude that the powder particles are PS. The particle sizes of all powders shift from a number of to two hundred micrometers (Figure. 4, a, c, e). The arrangement of PS powders happens in such a way that the permeable fabric is divided into particles of the same measure, in any case of the measure of the particles of the initial silicon dioxide. A PC test made utilizing rice body crude fabric features a somewhat diverse morphology than other tests. Its silicon crystallites take after plant strands (Figure. 4b). Whereas tests based on bamboo husks and internodes have a comparable morphology and take after an exceedingly permeable wipe (Figure. 4, d, f). Usually due to the fact that PC acquires the morphology of the initial plant fabric.

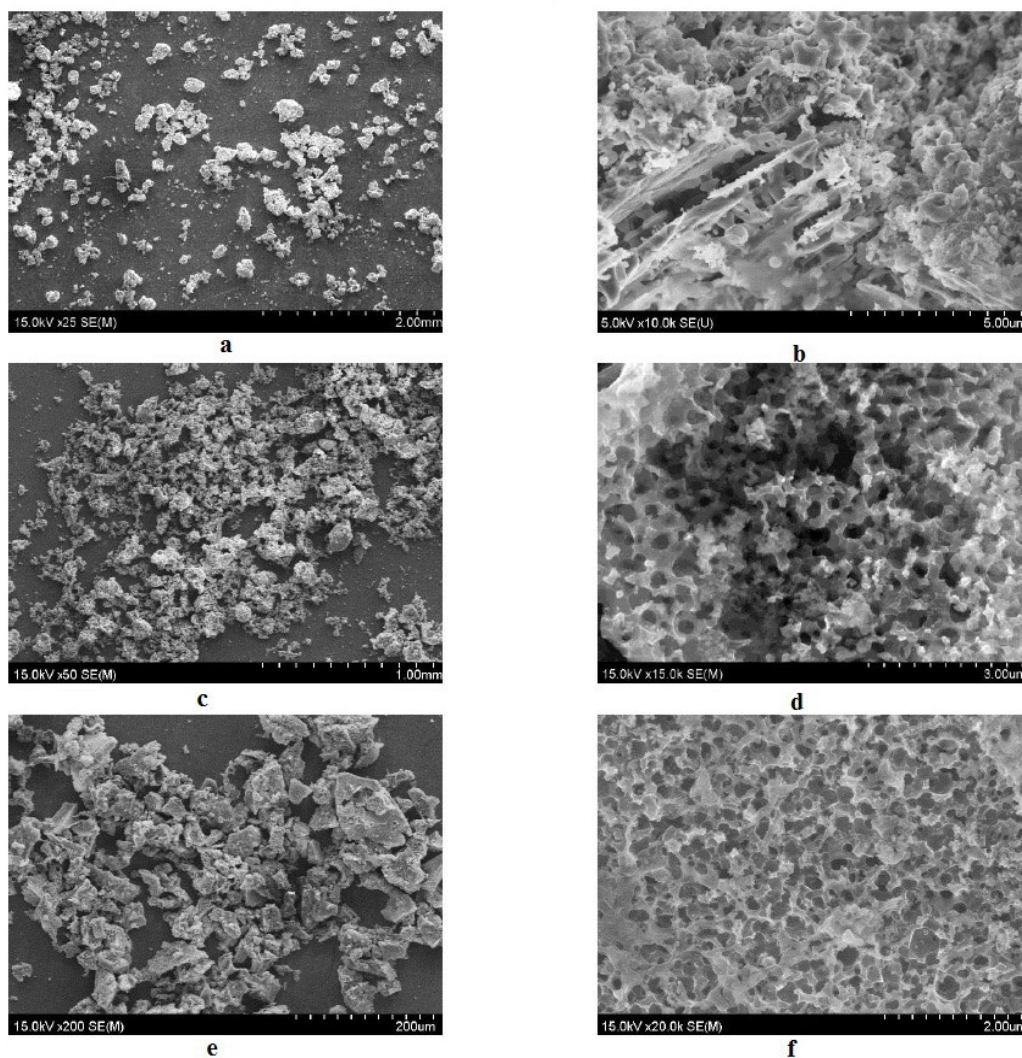


Figure 4 SEM photos of the surface of PS powder particles gotten by magnesium-thermal diminishment of silicon dioxide based on (a, b) rice husk, (c, d) bamboo husk, and (e, f) bamboo internodes.

6. CONCLUSIONS

In the method of performing this work, powders comprising of PS particles with pore sizes of the submicron extend were arranged by magnesium-thermal diminishment of silica powders of plant root. It has been set up that the silicon core of PS includes a polycrystalline nature. It was expected that its surface is to a great extent oxidized when uncovered to discuss. PC tests based on bamboo interstices contain the littlest sum of silicon molecules, which demonstrates inadequately get to of magnesium within the response mixture to silicon dioxide. Typically, due to the little particular surface range of the feedstock particles. It is appeared that the PS structure is decided by the nature of plant silicon dioxide. This makes it conceivable to differ the morphology of the permeable fabric over a wide run by selecting the starting plant fabric.

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