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Study On Role Of Nano Particles With Special Reference To Mechanical Industries

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Abstract

15 pieces of coconut fruits were selected and manually separated into coir, shell, and meat. The coir and shells were sun-dried for 14 days before calcination in a muffle furnace. The samples were put in the furnace and then heated at 6oC/min to 700 oC. The temperature was held for 3 hours and then off with samples left to cool for 12 hours. Afterward, the samples were removed and labeled as coconut coir ash (CCA) and coconut shell ash (CSA) for coir and shell, respectively. 2.2.2. production of silica. 23 g of CCA and CSA were leached with 1.0 M HCl and stirred at 600 rpm for 60 min. Residues were obtained after filtration and rinsing with DDW and then dried in the oven at 105 oC for 24 hours. The dried samples were labeled TCCA and TCSA for CCA and CSA, respectively. For the preparation of sodium silicate from CCA, CSA, TCCA, and TCSA, 12 g of each were added to NaOH at 90 oC for 60 min. 3.0 and 1.0 M of NaOH were used for TCCA and TCSA and 3.0 M for CCA and CSA, respectively. The mixture was allowed to cool and then filtered using Whatman No 1 filter paper. The filtrate was titrated with 1.0 M HCl until the pH of 6.0 to ensure the neutralization of the initial NaOH. This is marked with precipitates of silica gel dispersed in the solution below a pH of 10. This was left to age for 18 hours to get clear supernatant and NaCl solution. The supernatant was decanted, and the remaining silica gel solution was centrifuged at 4000 rpm for 10 mins. The supernatant was decanted, and DDW was added for washing. This step was repeated 3 times. The silica gel obtained was then dried in an oven at 65oC for 24 hours. The silica obtained was then ground for characterization.

Key words : furnace, filtration and rinsing, supernatant, supernatant, characterization.

Introduction

The importance and benefits of composites mainly thermoset polymers has extraordinarily increased their utilization in many industrial applications. The composites with high strength and lower weight, very low density, and high specific characteristics have shown rise in comparison to synthetic materials like metals, glass etc.. It is noticeable that in composites, the complete product's attributes can be converted to a particular convenient design from a correct assessment of matrix and reinforcing component. Various plants and plant fibres derived from waste are utilized as reinforcing particles to many of the applications. This decreases the cost of fabrication and gives easiness to utilize the materials from waste stage which in return reduces the environmental pollution. Reinforcing components, like polyethylene along with nanoparticles is used to fabricate and develop composite laminates, that significantly improved their internal properties. As it is observed that polymers reinforced with glass fibres possess superior characteristics, their use is limited becauseof greater cost of fabrication. The natural cel- lulose material such as, coconut shell nanoparticles have good characteristics for using it as reinforcement in composite polymers. This coconut shell powder particles have been converted into a useful material for filler because of some characteristics like higher strength and Young's modulus .

Most analysts who study strong impetuses center around the responses they intervene. In any case, a few researchers in that field are creating atomic level comprehension of the union strides by which those composite materials are made. They are concocting new techniques to test and control the size, scattering, morphology, steadiness, and different properties of reactant solids, and they are attempting to urge others to go along with them in their journey.

"Increasingly more nowadays, we hear the call to change the craft of impetus planning into a science. However that call isn't being regarded as intently as it ought to be," said John R. Regalbuto, a teacher of substance designing at the University of Illinois, Chicago. Regalbuto, who by and by is filling in as a National Science Foundation catalysis program chief, is one of a few researchers who introduced late discoveries on impetus amalgamation last month at the American Chemical Society meeting in Salt Lake City. The analysts accumulated at a discussion supported by the Division of Catalysis Science and Technology (trial).

For quite a long time, strong impetuses have driven the mind-boggling greater part of modern substance measures. As per industry gauges, over 80% of the present huge scope substance measures rely upon strong impetuses, which are otherwise called heterogeneous impetuses in light of the fact that these solids are insoluble in the gas and fluid reagents they change. For instance, most changes in oil refining, contamination decrease and creation of powers and synthetics are worked with by upheld impetuses. These composite materials regularly comprise of nanometer-sized metal particles joined to permeable metal oxides, zeolites, carbon, and other high-surface-region upholds and different mixes of solids.

Review of literature

Applications in the environment

The increasing area of engineered NPs in industrial and house-hold applications leads to the release of such materials into the environment. Assessing the risk of these NPs in the environ- ment requires on understanding of their mobility, reactivity, Eco toxicity and persistency (Ripp and Henry, 2011; Zhuang and Gentry, 2011). The engineering material applications can increase the concentration of NPs in groundwater and soil which presents the most significant exposure avenues for assessing environmental risks (Golobicˇ et al., 2012; Masciangioli and Zhang, 2003). Due to high surface to mass ratio natural NPs play an important role in the solid/water partitioning of contaminants can be absorbed to the surface of NPs, co-precipitated during the formation of natural NPs or trapped by aggregation of NPs which had contaminants adsorbed to their surface. The interaction of contaminants with NPs is dependent on the NPs characteristics, such as size, composition, morphology, porosity, aggregation/disaggrega- tion and aggregate structure. The luminophores are not safe in the environment and are protected from the environmental oxygen when they are doped inside the silica network (Swadeshmukul et al., 2001).

Most of environmental applications of nanotechnology fall into three categories:

1. Environmentally benign sustainable products (e.g. greenchemistry or pollution prevention).
2. Remediation of materials contaminated with hazardoussubstances and
3. Sensors for environmental stages (Tratnyek and Johnson,2006).

The removal of heavy metals such as mercury, lead, thallium, cadmium and arsenic from natural water has attracted considerable attention because of their adverse effects on environmental and human health. Super paramagnetic iron oxide NPs are an effective sorbent material for this toxic soft mate- rial. So, for no measurements of engineered NPs in the environment have been available due to the absence of analytical methods, able to quantify trace concentration of NPs (Mueller and Nowack, 2008). Photo degradation by NPs is alsovery common practice and many nano materials are utilized forthis purpose. Rogozea et al. used NiO/ZnO NPs modified silica in the tandem fashion for photo degradation purpose. The high surface area of NPs due to very small size (<10 nm), facilitated the efficient photo degradation reaction (Rogozea et al., 2017). The same group has reported the synthesis of variety of NPs and reported their optical, florescence and degradation applications (Olteanu et al., 2016a, 2016b; Rogozea et al., 2016).

1.1. Applications in electronics

There has been growing interest in the development of printed electronics in last few years because printed electronics offer attractive to traditional silicon techniques and the potentialfor low cost, large area electronics for flexible displays, sensors. Printed electronics with various functional inks containing NPs such as metallic NPs, organic electronic molecules, CNTsand ceramics NPs have been expected to flow rapidly as a massproduction process for new types of electronic equipment (Kosmala et al., 2011).

Unique structural, optical and electrical properties of one dimensional semiconductor and metals make them the key structural block for a new generation of electronic, sensors and photonic materials (Holzinger et al., 2014; Millstoneet al., 2010; Shaalan et al., 2016).

The good example of the synergism between scientific dis- covery and technological development is the electronic indus- try, where discoveries of new semiconducting materials resulted in the revolution from vacuumed tubes to diodes and transistors, and eventually to miniature chips (Cushing et al., 2004).

The important characteristics of NPs are facile manipula- tion and reversible assembly which allow for the possibility of incorporation of NPs in electric, electronic or optical devices such as ‘‘bottom up” or ‘‘self-assembly” approaches are the bench mark of nanotechnology (O’Brien et al., 2001).

Recent studies warned us about the limitations and scarcity of fossil fuels in coming years due to their nonrenewable nat- ure. Therefore, scientists shifting their research strategies to generate renewable energies from easily available resourcesat cheap cost. They found that NPs are the best candidate for this purpose due to their, large surface area, optical behavior and catalytic nature.

Especially in photo catalytic applications, NPs are widely used to generate energy from photo electrochemical (PEC) and electrochemical water split- ting (Avasare et al., 2015; Mueller and Nowack, 2008; Ning et al., 2016). Beside water splitting, electrochemical CO_2 reduction to fuels precursors, solar cells and piezoelectric gen- erators also offered advance options to generate energy (Fang et al., 2013; Gawande et al., 2016; Lei et al., 2015; Li et al., 2016; Nagarajan et al., 2014; Sagadevan, 2015; Young et al., 2012; Zhou et al., 2016). NPs also use in energy storage applications to reserve the energy into different forms at nanoscale level (Greeley and Markovic, 2012; Liu et al., 2015a, 2015b; Sagadevan, 2015; Wang and Su, 2014). Recently, nanogenerators are created, which can convert the mechanical energy into electricity using piezoelectric, which is an unconventional approach to generate energy (Wanget al., 2015). Fig. 13 shows some energy generating devices, and uses NPs.

Material and Method

Preparation of coconut coir and shell ashes. 15 pieces of coconut fruits were selected and manually separated into coir, shell, and meat. The coir and shells were sun-dried for 14 days before calcination in a muffle furnace. The samples were put in the furnace and then heated at 6oC/min to 700° C. The temperature was held for 3 hours and then off with samples left to cool for 12 hours. Afterward, the samples were removed and labeled as coconut coir ash (CCA) and coconut shell ash (CSA) for coir and shell, respectively. production of silica. 23 g of CCA and CSA were leached with 1.0 M HCl and stirred at 600 rpm for 60 min. Residues were obtained after filtration and rinsing with DDW and then dried in the oven at 105°C for 24 hours. The dried samples were labeled TCCA and TCSA for CCA and CSA, respectively. For the preparation of sodium silicate from CCA, CSA, TCCA, and TCSA, 12 g of each were added to NaOH at 90°C for 60 min. 3.0 and 1.0 M of NaOH were used for TCCA and TCSA and 3.0 M for CCA and CSA, respectively. The mixture was allowed to cool and then filtered using Whatman No 1 filter paper. The filtrate was titrated with 1.0 M HCl until the pH of 6.0 to ensure the neutralization of the initial NaOH. This is marked with precipitates of silica gel dispersed in the solution below a pH of 10. This was left to age for 18 hours to get clear supernatant and NaCl solution. The supernatant was decanted, and the remaining silica gel solution was centrifuged at 4000 rpm for 10 mins. The supernatant was decanted, and DDW was added for washing. This step was repeated 3 times. The silica gel obtained was then dried in an oven at 65oC for 24 hours. The silica obtained was then ground for characterization. Characterization Silica produced from CCA, CSA, TCCAs and TCSAs were characterized with SEM, EDX, XRD, and FT-IR. SEM was carried out to investigate the morphology and sizes of the silica. EDX was carried out to investigate the chemical composition and invariably the purity of the silica. XRD was to determine the structure of the prepared silica, while FT-IR investigation was carried out to know the functional groups present.

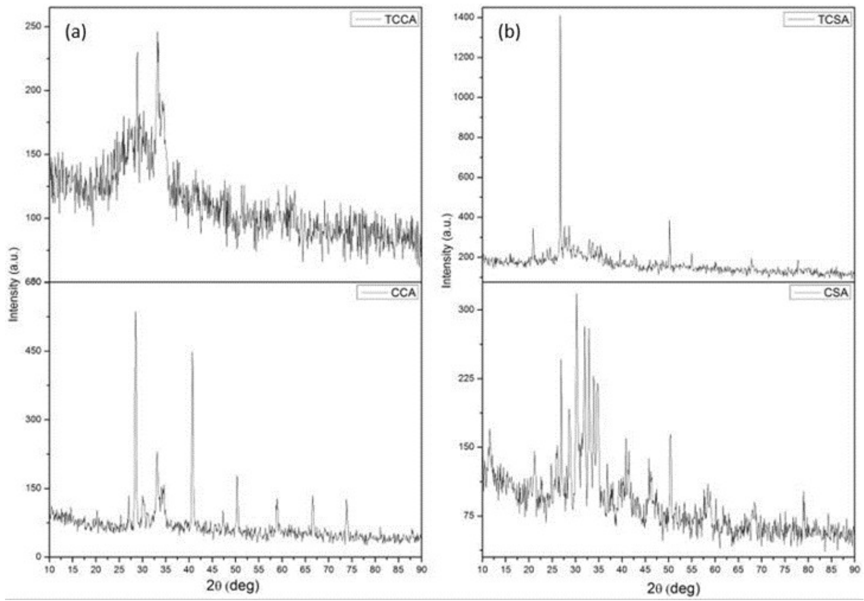

Figure 2 (a) shows that acid treatment of CCA removed some crystalline phases of metallic oxides marked by disappearance or reduction of crystalline peaks at diffraction angles 27, 41, 50, 58, 63, and 78. This is similar to what is observed in Figure 2 (b) but with some insoluble phases present in treated coconut shell ash. The leaching efficacy of the acid is observed in both coconut coir and shell ashes. This procedure has been reported to be effective for obtaining pure silica [55]. The presence of amorphous silica, which is extractable can, is observed in both the treated and untreated coconut coir and shell ashes. This spread is located between the angle of diffractions 15 and 40°.The crystalline peaks form are unwashed NaCl from the solution. The peaks are found to correspond to JCPDS card nos: 78-0751 and 01-0994. The sodium chloride, is due to the neutralization of NaOH reagent used for solation by HCl. This phase can be removed using hot water washing and rinsing that has been reported to be effective for removing any traces of NaCl . The major impurity in the silica obtained is aluminum (as Al2O3) which is an amphoteric oxide. This forms precipitates when leached with acid and soluble hydroxide when treated with base. Using a weak base for the solation of CCA yields silica free of aluminum, while it seems difficult for CSA. Hence, the removal of this oxide is a concern. The Na and Cl present can be removed by hot water washing or repeated washing of the silica gel until free of the salt. Figure 4 shows that all the silica produced is below 100 nm. This is due to the method used, which is categorized as an appropriate approach to the synthesis of nanoparticles categorized as a bottom-up approach in the review of Adebisi, Agunsoye. The micrographs also show that there is agglomeration in the procedure used.

Conclusion

In this research, we presented a detail overview about coconut NPs, their types, synthesis, characterizations, physiochemical properties and applications. Through different characterization techniques such as SEM, TEM and XRD, it was revealed that NPs have size ranges from few nanometer to 500 nm. While the morphology is also controllable. Due to their tiny size, NPs have large surface area, which make them suitable candidate for various applications.

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