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Novel Techniques in Chemistry and Physics and Current Applications for Discovering the Physical and Chemical Compounds

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Abstract

Physical and chemical techniques have gained special interest for discovery of novel materials, nanoparticles characterization, crystals and metallic based characterization and semiconductor based materials. Nanotechnology has made tremendous advances and infinitely divisible into smaller pieces, or composed of small, indivisible and indestructible particles in the form atoms. Different approaches have used for designing of nanoparticles. Physical and chemical methods have been used for the synthesis of nanoparticles, although, some of them needed more advances for high quality and biodegradable materials to meet the industrial demands. Carbon and silica based nanoparticles can be designed in order to improve the rubber properties , while on the other hand, carbon based nanoparticles can be used for improving the polymers to increase their strength and impact resistance. Semiconductor quantum dots also made revolutionary advances for replacing the toxic materials employed. Nuclear magnetic resonance spectroscopy is the most important type of spectroscopy that helpful for industrial promotions of magnetic nanoparticles. High-performance liquid chromatography is the most important technique used in physics and chemistry in components in the given sample can be identifying easily within short period of time. Different nanoparticles can be easily accessed through Powder X-ray diffraction. One of the examples is silver nanoparticles. Crystallization is one of the most important process for solidification of atoms or molecules in such a way that they get shape the crystal.

Keywords: Physical and chemical techniques, nanoparticles, characterization, crystals and , semiconductor, quantum dots.

INTRODUCTION

Different techniques are used for evaluating of samples in chemistry and physics as appropriate analysis leads to accuracy of final results. Physical and chemical techniques have gained special interest for discovery of novel materials, nanoparticles characterization, crystals and metallic based characterization and semiconductor based materials. The ultimate goal is to make significant contributions to the physical and chemical sciences in order to achieve more convenient methods for chemical and physical analysis [1, 2]. The most important separation-based instrumental techniques such as high-performance liquid chromatography (HPLC), gas chromatography (GC), supercritical fluid chromatography (SFC), capillary electrophoresis (CE), and capillary electrochromatography (CEC), have been used for analysis of samples testing at physical and chemical level. These techniques offer the variety of significant results and more accuracy while on the other hand, traditional techniques used in chemistry and physics leads to inappropriate analysis, low accuracy and hence poor finding in the chemical and physical evaluation [3, 4].

Indirect approach is the most significant in chemical and physical sciences where a variety of enantiomers react in such a way that for forming the

properties of diastereoisomers. These isomers different from each other on the basis of physical and chemical properties. They also separated by achiral stationary phases used for chemical and physical combinations in chromatography or achiral background electrolytes[2-3]. While, the other approaches uses the nanotechnology to meet the industrial demands and high quality materials intends to use of matter on an atomic, molecular, and supramolecular scale. Chemicals are evaluated on the basis of different properties. These are coordination number, flammability, enthalpy of formation, heat of combustion, oxidation states, chemical stability.

Different materials are used in different industries on the basis of specific properties selected to make them desirable and increase their demand. These properties are density, melting point. thermal conductivity. Electrical conductivity, thermal expansion, corrosion resistance. Various optical imaging methods have been used for evaluation of optical properties and isotopic labeling that allow the fine detection of chemical and physical materials. The exact mechanism of action is lies behind, trace metals cannot allow reacting in order to archived the materials with high conducting properties. Radioactive agents also used for ease their detection at chemical and physical levels; radioactive agents may cause hazards to cell survival and waste issues. Therefore, interference of toxic agents my decrease the reliability of materials [5, 6].

Nanotechnology is the most multidisciplinary branch that deals with atoms and molecules by using the nanoparticles in order to synthesize the novel particles with high mobility, excellent conducting properties. Nanotechnology has made tremendous advances and infinitely divisible into smaller pieces, or composed of small, indivisible and indestructible particles in the form atoms. Different approaches have used for designing of nanoparticles. These are top-down approach is essentially the breaking down of bulk material to get nano-sized particles. This approach is important in designing of novel materials with industrial demands. It depends upon the metallic parts used to make the compatible structure ideal for precision engineering supports the majority of the micro-electronics industry during the entire production process. Through this type of approach, a variety of materials in the form of diamond or cubic boron nitride can be shaped into final product that possess the availability of insulation layer to the nanoparticles surfaces [7-9].

Table-1: Shows the physical and chemical properties/methods and their principles

Physical/Chemical approach	Principle	Significance	Uses
high-performance liquid chromatography, gas chromatography (GC), supercritical fluid chromatography, capillary electrophoresis (CE), and capillary electrochromatography	They are used for analysis of samples testing at physical and chemical level. These techniques offer the variety of significant results and more accuracy both physical and chemical testing.	Most important technique used in physics and chemistry in components in the given sample can be identifying easily within short period of time to study the properties of organic molecules, crystal properties, and atoms of nuclei study where nuclear spins aligned in a magnetic field	Electrical conductivity (resistivity), thermal expansion. Corrosion resistance. Various optical imaging methods have been used for evaluation of optical properties and isotopic labeling that allow the fine detection of chemical and physical materials
Nanotechnology	Multidisciplinary branch that deals with atoms and molecules by using the nanoparticles in order to synthesize the novel particles with high mobility, excellent conducting properties.	A variety of materials in the form of diamond or cubic boron nitride can be shaped into final product that possess the availability of insulation layer to the nanoparticles surfaces	Assembly of atoms and molecules can be made through combinations of nanoparticles.
Semiconductor quantum dots	Also made revolutionary advances for replacing the toxic materials employed	Lead is a toxic metal has been replaced with fine layer of nanoparticles that make more compatible and fine nontoxic quantum dots.	Through this technology, different types of semiconductors with fine layers of nanoparticles have been made for example, copper-containing semiconductor nanoparticles.
Powder X-ray diffraction (XRD)	common type used for characterization purposes and most wieldy used in chemistry and physics for the determination of size as well as shape for partouclar unit cell of those compounds under investigation	Powder X-ray diffraction has several advantages over to various microscopic and spectroscopic methods	Different nanoparticles can be easily accessed through Powder X-ray diffraction. One of the examples is silver nanoparticles

The other approach is the bottom-up approach that integrated the similar types of arrangements such as atom or atom. This can be performed by using the physical methods through nano encapsulation. Physical and chemical methods have been used for the synthesis of nanoparticles, although, some of them needed more advances for high quality and biodegradable materials to meet the industrial demands. Chemical method is the

application of directly applied different types of chemicals to the fine layers of nanoparticles. It depends upon the purity of materials employed for their synthesis. Impure materials in the preparation of nanoparticles leads poor and low grade materials with poor insulation that can be damaged by environmental stresses. While on the other hand, high quality materials in the preparation of nanoparticles improved the grade materials with excellent insulation that can resist the environmental stresses. Assembly of atoms and molecules can be made through combinations of nanoparticles. Many properties unique to nanoparticles are related specifically to the particles' size into composite materials. One of the ideal example is the nanocomposite material with modern rubber tire that is composed of rubber with inorganic filler in the form of a reinforcing particle, such as carbon black or silica nanoparticles [10-12].

Novel techniques in Chemistry and Physics

Carbon and silica based nanoparticles can be designed in order to improve the rubber properties for use in tire, while on the other hand, carbon based nanoparticles can be used for improving the polymers to increase their strength and impact resistance. For example, use of non-petroleum-based polymers has high ability to conduct the electrons with larger surface area that ultimately increase their string capacity. This property of nanoparticles is valuable for use in batteries and supercapacitors. Composite materials on the basis of carbon particles for making the grapheme [13-15].

Semiconductor quantum dots also made revolutionary advances for replacing the toxic materials employed. For example, lead is a toxic metal has been replaced with fine layer of nanoparticles that make more compatible and fine nontoxic quantum dots. Through this technology, different types of semiconductors with fine layers of nanoparticles have been made for example, copper-containing semiconductor nanoparticles. Their optical properties showed that they have excellent ability at luminescent solar concentrators [3, 16, 17]. Due to smaller size of nanoparticles, they are used for improving the photocatalytic efficiencies with larger surface area. This also leads to increase their absorption capacity. The most commonly employed photo catalyst material is titanium dioxide. This type of combinations makes them more photostable, chemically stable, photoactive, relatively inexpensive and non-toxic. The high band gap is found in case of insulators for appropriate oxidoreductions [4, 8, 11].

Nuclear magnetic resonance spectroscopy is the most important type of spectroscopy that helpful for industrial promotions of magnetic nanoparticles. These nanoparticles show movement on the basis of either clock or anticlockwise. In this technique, sample is usually placed on the magnetic field due to which, NMR signals are produced that transmit through radio waves. The magnetic field around an atom in a molecule changes the resonance frequency, thus giving access to details of the electronic structure of a molecule and its individual functional groups [18-20].

When sample placed in the magnetic field, absorption occurs through the electromagnetic radiations. A signal is produced that indicates the sample peak and receiver then pick the incoming signals. Usually, 1H NMR spectra that can be attained maximum peaks up to 16 that last for few minutes. While on the other hand, some other elements peaks last few seconds those are heavier than hydrogen. Finally, quantitative heavy-element spectra can be time-consuming as heavy metals can cause the noise pollution. There is need to improve it through nanotechnology that employed the efficient elements with no noise pollution. In this way, nanosensors that detect the signals incoming the detector that leads to the final peaks optimization [20-22].

Nuclear magnetic resonance spectroscopy usually allows the nuclei of the atoms under the influence of magnetic field. Nuclear magnetic resonance (NMR) occurs under the nucleic movement by oscillating magnetic field; the nuclei generate an electromagnetic signal. Nuclear magnetic resonance spectroscopy is widely used in the fields of chemistry and physics to study the properties of organic molecules, crystal properties, and atoms of nuclei study where nuclear spins aligned in a magnetic field. Nuclear magnetic resonance spectroscopy also used for studying the physical and chemical properties of atoms, also it interaction with nature. The other applications of nuclear magnetic resonance spectroscopy to elucidate the structures of chemical compounds and perform quantitative analysis, especially for the physical and condensed matter based objects. But, there is need to link it with nanotechnology through which development of new elements and their nuclei can be study under the influence of magnetic field. In this way, nanotechnology helpful for discovering the novel properties of atoms and their nuclei [23-25].

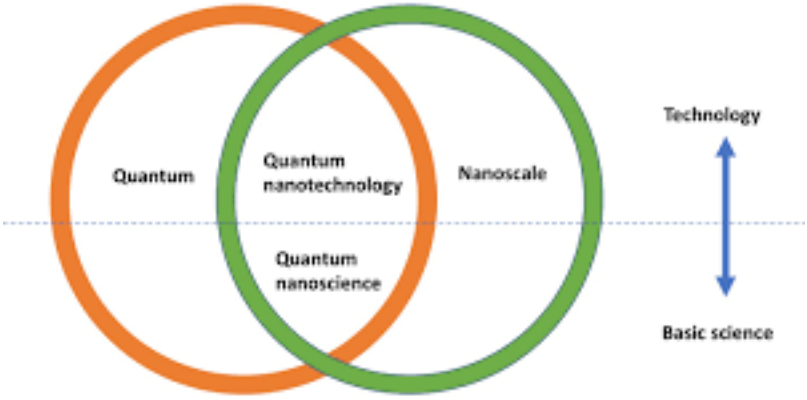

Fig-1: Shows the role of nanotechnology in physical and basic sciences

High-performance liquid chromatography is the most important technique used in physics and chemistry in components in the given sample can be identifying easily within short period of time. While on the other hand, traditional techniques required extensive materials preparation and hence time consuming. High-performance liquid chromatography systems are made up of a mobile phase, pump, injector, column, and detector. The appropriate schematic flow of materials can be passed though column of High-performance liquid chromatography. Any impurity in the column of High-performance liquid chromatography leads to poor identification of target solvents [26-28].

High-performance liquid chromatography allows the different components of in the sample interacts differently with the adsorbent material. Their appropriate interaction leads to different flow rates that increased the chances of detections different elements in the particular sample. In physics, different properties of objects or materials can be studied through high-performance liquid chromatography where atoms detections, their flow rate accessing and determination their conducting properties. In the field of chemistry, properties of different solvents and their use at industrial level may increase the detection of those solvents that are not identified earlier. Sometimes, error in the flow column of high-performance liquid chromatography can cause serious trouble shooting and technical evaluation of HPLC system required as it is very sensitive technique. Through the advances in nanotechnology, scientists are working to improve the flow rate by columns [29, 30].

Powder X-ray diffraction (XRD) is a common type used for characterization purposes and most wieldy used in chemistry and physics for the determination of size as well as shape for partouclar unit cell of those compounds under investigation. Powder X-ray diffraction has several advantages over to various microscopic and spectroscopic methods. X-ray diffraction (XRD) is a also helpful for analyzing the structure of materials, primarily at the atomic or molecular level. X-ray diffraction also employed for those crystalline or partially crystalline. Before a sample can pass through X-ray diffraction analysis, there is need to confirm the crystalline nature. By confirm the crystal nature, there is easy to integrate the analysis with nanotechnology as it ir more reliable as compared to the traditional techniques. There are different recent advances have been made to some diffraction techniques for accurate analysis through integration with the nanotechnology. Different nanoparticles can be easily accessed through Powder X-ray diffraction. One of the examples is silver nanoparticles [30, 31].

Crystallization is one of the most important process for solidification of atoms or molecules in such a way that they get shape the crystal. This process sometimes takes long time for the crystal formation due to specific nature of compound. It has different applications in the field of physics. For example, decreasing the temperature to increase of the viscosity of a solution. High viscosity can cause serious problems in hydraulic systems that ultimately leads to affected the crystallization dynamics. Pattern or characteristic of a crystalline solid, forming a site upon which additional particles are deposited as the crystal grows. During this formation, it from a pure melt or directly from deposition from the gas phase that is affected by temperature and pressure and nature of compound. High or low temperature /pressures exerted on crystals formation. Crystallization of the magma is crucial as it takes lots of time and complex substance. It is composed of granites, contain several percent water that get cools and form the crystals. It has wide range of applications in the field of chemistry. For instance, decreasing the temperate can leads the precipitate in hydrate form as mass of water in that case can cause the crystallization. Different particles of hydrate accumulated in such a way that they forming the crystals like sodium chloride [32-34].

CONCLUSION

Although, different techniques are used in chemistry and physics for evaluating the materials. Some of them are nanotechnology, crystallography, high-performance liquid chromatography, gas chromatography, supercritical fluid chromatography, capillary electrophoresis, and capillary electrochromatography. Future research indeed on the discovery of novel materials in combinations with nanomaterials.

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