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Atomic Structure and Binding of Carbon Atoms

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Abstract: Many studies discuss carbon-based materials because of the versatility of carbon element. These studies deal with different ideas and discuss them within the scientific scope and application. Depending on the processing conditions of carbon precursor, carbon exists in its various allotropic forms. Electron transfer mechanism is responsible for converting the gaseous carbon atom into the various carbon states named graphite, nanotube, fullerene, diamond, lonsdaleite and graphene. To convert the carbon atom from existing state to a new state, two pieces of dash-shaped typical energy involve transferring filled state electrons to nearby unfilled states. In an electron transfer mechanism, the carbon atom preserves its equilibrium state. Through the involved typical energy, filled state electrons instantaneously and simultaneously transfer to the unfilled states. The involved dash-shaped typical energy has its conserved behavior that is partial. A transferring electron is also under the partially conserved forces. Carbon atoms in graphite, nanotube and fullerene states evolve and develop the structures partially. The structures of one dimension, two dimensions and four dimensions are formed respectively. In the formation of such structures, atoms bind by the pieces of same involved dash-shaped typical energy. The graphite structure under the attained dynamics of atoms only is also formed, but in two dimensions or in amorphous carbon. Here, force and energy, chemical in nature, together contribute. The structural formations in diamond, lonsdaleite and graphene state atoms involve a different shaped typical energy. Such typical energy controls the orientation of electron while undertaking its one additional clamp of energy knot. The involved typical energy has a form like golf-stick. To undertake one additional clamp of energy knot, all four electrons (of the outer ring) in depositing diamond state atom get aligned along the south pole and all four unfilled energy knots (of the outer ring) in deposited diamond state atom get stretched along the east-west poles. In this way, a depositing diamond state atom binds to the deposited diamond state atom from ground to south. Growth is from south to ground, so the structure of diamond is ‘tetra-electron topological structure’. Binding of lonsdaleite state atoms is from ground to a bit south. To nucleate glassy carbon, layers of gaseous, graphite and lonsdaleite state atoms bind simultaneously. To grow glassy carbon, these layers repeat in the binding process. Mohs hardness of the nanostructured and microstructured carbon is also sketched.

Keywords: Carbon; Atomic structure; Electron dynamics; Potential energy; Binding

1.0. Introduction

To develop carbon-based materials in selective size, new approaches are required. In the characterizations and analyses of a carbon-based materials, a new science at both basic and applied levels can be explored. A force exerting at the electron level should also explain the role of energy at the electron level [1-3]. In the structural formation of carbon, when the atoms involve the partially conserved energy, they should also engage the partially conserved force. However, when the atoms involve the non-conservative energy, they should also engage the non-conservative force. When the atoms neither involve nor engage the force and energy, chemical in nature, force and energy should together contribute.

At the electron level, the involved energy should direct the engaged force at the electron level. Same can be the case for atoms and nano-objects. A partial conservative energy engages a partial conservative force at the electron level, which should be the case in atoms of graphite, nanotube and fullerene states. A non-conservative energy engages a non-conservative force at the electron level, which should be the case in atoms of diamond, lonsdaleite and graphene states.

Due to the presence of filled and unfilled states close to the center of carbon atom, electrons of the outer rings do not deal with the conservative force. The relation of energy and force in such atoms can be anticipated either in the partially conserved mode or in the non-conserved mode. This can depend on the state of a carbon atom. Carbon has different states, which are known in the allotropes, i.e., starting from the gaseous state to graphite state, and then diamond state, lonsdaleite state, fullerene state followed by the nanotube state, graphene state, and finally glassy carbon. In the literature, several studies have mentioned about these states.

In silicon atom when the conservative forces are being exerted to the electron, an uninterrupted execution of its dynamics generates a photon of continued length [2]. This indicates that the built-in interstate gap of electron dynamics in carbon atom is different from the silicon atom. In the outer ring, both carbon atom and silicon atom possess the equal number of filled and unfilled states. However, electrons of the outer ring in carbon atom display different distance from the electrons of the outer ring in silicon atom. A silicon atom keeps the zeroth ring, first ring and outer ring but a carbon atom keeps only the zeroth ring and outer ring [3]. In the conversion of carbon atom to another state, an electron transfer mechanism should be different. In the atoms of those elements executing confined interstate electron dynamics, they evolve the structures in the relevant formats of the exerting forces rather than form or develop the structures [4]. Atoms belonging to all elements do not ionize [5].

Different spectroscopic analyses of carbon film show peaks at different positions, which indicate that carbon atoms amalgamated to develop tiny grains [6]. Depending on the conditions of processing, carbon atoms deposit in different morphology and structure of grains and crystallites [7]. A different morphology of grains and particles resulted at different chamber pressures identifying the role of typical energy binding the atoms [8]. The deposition of graphite and diamond in different regions of the single substrate is due to different inter-wire distance [9]. Different carbon-based materials contain atoms of the same element but they specify different behaviors in their analysis [6-9]. Thus, the electron transfer mechanism is responsible to change the chemical nature of an atom regardless of that it belongs to the same element.

The force entering from the north pole and leaving the ground surface for the south pole behaves differently as compared to the force at the ground surface [10]. Gaseous and solid atoms deal with the transitions while undertaking the liquid states where the electrons remain within their occupied energy knots [3]. Atoms of gaseous, semisolid and solid deal with different ground points [4].

A recent study shows the transformation of graphene film into a diamond like carbon film, where the elastic deformations and chemical natures were changed [11]. Wu *et al*. [12] reviewed the developments in Raman spectroscopy of graphene-based materials. Uniform carbon nanofibers were grown by vapor deposition method without involving catalyst [13]. Different applications related to graphene hybrids were reviewed [14]. Nitrogen incorporated carbon dots were used to modify a glassy carbon electrode [15]. A novel energy dissipation system was investigated by combining the carbon nanotube and buckyballs [16]. Different carbon allotropes were studied for dehydrogenation of temperature in their comparison [17]. A precise positioning of the vacancies within the diamond crystal was studied by Chen *et al*.

[18]. Liu *et al*. [19] presented an efficient strategy to fabricate the graphite-graphene Janus architecture. Repeated large-area doped nano-crystalline diamond layers were prepared under the optimized conditions of the deposition system [20].

Cheng and Zong [21] observed a structural evolution of damaged carbon atoms for deeper surface layer. Maruyama and Okada [22] investigated geometric, electronic and magnetic structures of a two-dimensional network of carbon atoms. Narjabadifam *et al*. [23] studied both elastic and failure properties of carbon nanocones through the application of molecular dynamics simulation. Levitated nanodiamonds burn in the air because of the presence of amorphous carbon on their surfaces, and they deal with uncertainty in the measurement of their temperature [24]. This leads to the removal of uncertainty in temperature measurement of levitated nanodiamond, which paves the way for considerable applications [25].

A layout of atomic structure in different states of the carbon atoms is not clear along with the binding mechanism in identical state carbon atoms. What is the nature of force and behavior of energy in electron transfer mechanism as well as in binding the same state carbon atoms is discussed here. The formation mechanism of glassy carbon is also not clear. A structural formation in glassy carbon is also discussed.

2.0. Experimental Details

This work does not contain the experimental details. However, many published studies on the topic describe the experimental details. For example, the processing of carbon-based materials in the form of thin and thick films by both microwave and hot-filament techniques have been discussed by enormous publications. There are several techniques and methods depositing and synthesizing carbon materials, and they can be referred from the studies given in the reference list and literature.

However, a process of optimization is required in depositing or synthesizing each allotropic form of the carbon. In the depositing or synthesizing carbon materials having the mixed phases, the process of optimization is also required. Nevertheless, to optimize the parameters in obtaining the specific quality of a carbon material, a useful information can be gathered from the earlier published studies.

This study purely deals with the underlying science of formation of different allotropes in a carbon element. In the structural formation, how the atoms of same state carbon bind is also discussed. Mohs hardness of the nano and micro-sized carbons is also plotted with preliminary detail, in estimation.

3.0. Results and Discussion

3.1. Structures of different states carbon atoms

Understanding the formation mechanism of electronic structure in different states of carbon, atoms rely on the same number of electrons. A carbon atom in any of the state has fixed numbers of filled and unfilled states. A change in the position of filled and unfilled state gives birth to the new chemistry of that atom. In the formation of carbon lattice, overt photons having a suitable length and number intercross to construct twelve states. In the intercrossing, overt photons keep the centres of their lengths at a common point.

Energy knots related to filled and unfilled states are constructed by precisely intercrossing of the overt photons. Overt photons keep the equal lengths. The lengths of the overt photons are in such a manner that their schedule crossing construct the filled and unfilled states required to form energy-knot-net of a carbon atom. Two pairs of overt photons, which have characteristics of photonic current, intercross along the east and west sides. Two pairs of photons, which have characteristics of photonic current, intercross along the north and south lines. All the intercrossed overt photons keep the positions of their mid-lengths at the same point.

In the formation of carbon lattice, two energy knots from each side of the centre remained compressed. This is due to the presence of surrounded states. In this way, a total number of eight states are constructed forming the outer ring of carbon atom. Four states are related to the filled states and four states are related to the unfilled states. Four energy knots of the central ring are related to the zeroth ring. The lattice or energy-knot-net of carbon atom is also shown in Figure 1 (a).

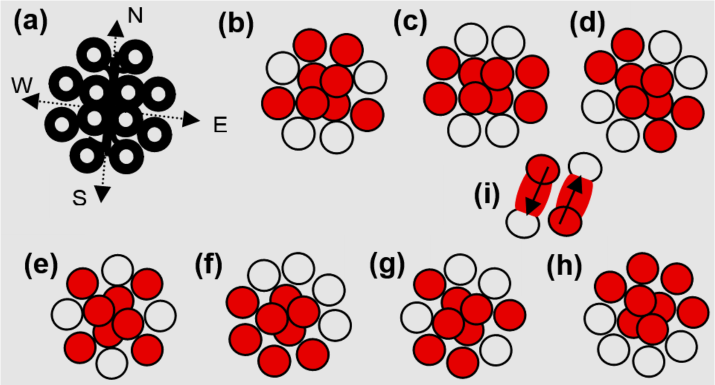


Figure 1: (a) Lattice of carbon atom. Atomic structure of carbon atom in the (b) gaseous state, (c) graphite state, (d) nanotube state, (e) fullerene state, (f) diamond state, (g) lonsdaleite state, (h) graphene state and (i) electron transferring to downward state and electron transferring to upward

state; red circles indicate filled states, white circles indicate unfilled states (sketch is drawn in estimation)

The lattice of a carbon atom is related to the energy-knot-net as shown in Figure 1 (a). On intercrossing the overt photons, the trough of one is in front of the crest of other, so the overt photons freeze their element of force wrapped by the energy [3].

In the gaseous carbon atom, four energy knots of the outer ring are filled. The states belonging to the zeroth ring are also filled by the electrons. In the outer ring, four states remained filled and four remained vacant. This order of the states provides the option to originate six different states of the carbon atom in addition to the gaseous state and glassy carbon. In Figure 1 (b), a gaseous carbon atom is shown. Other different states of the carbon atom are shown in Figure 1 (c-h); positions of the electrons belonging to the outer ring inter-changed in the carbon atom to form (c) graphite state, (d) nanotube state, (e) fullerene state, (f) diamond state, (g) lonsdaleite state and (h) graphene state. In each state of the carbon atom, four centered electrons form the zeroth ring. The zeroth ring is related to helium atom [3]. In Figure 1, the atomic structure of carbon having different states are shown, where electrons and energy knots are symbolized.

A gaseous carbon atom is processed for transferring two electrons of filled states to nearby unfilled states. One electron from the east side and one from the west side transferred to originate the new state of carbon atom. To migrate electrons from left and right sides of the atom, the involved dash-shaped typical energies provide the route to transfer filled state electrons, where the engaged force remains in its partial conservative behavior. The typical energy shaped like dash keeps the electron arrested till occupying the nearby unfilled state. Moreover, the engaged force facilitates the filled state electron to transfer to the nearby unfilled state safely. To convert the carbon atom in different states, one electron from the east (right) side and one from the west (left) side transfer to their nearby unfilled states.

When the gaseous carbon atom converts into the graphite state atom, the engaged forces are mainly related to the surface and space formats. The transferring electrons of graphite atom convert it into the lonsdaleite atom. A dash-shaped typical energy along the west to south and a dash-shaped typical energy along the east to south get involved. The exerted forces to the transferring electrons remain partially conserved, which are related to the surface format and a bit grounded format. During the conversion of graphite atom into lonsdaleite atom, only two electrons are transferred to the nearby positioned unfilled states. To convert lonsdaleite atom into diamond atom, two electrons are further transferred to the nearby positioned unfilled states. The ground point in the diamond atom goes further below the ground surface as compared to the ground point in the lonsdaleite atom. On transferring all four electrons of the outer ring to the energy knots available below the east-west line, the ground point in the diamond atom becomes fully grounded. A partial conservative energy gets involved as well as a partial conservative force gets engaged. Electrons are in the maximum potential energy, where the occupied energy knots also keep the maximum stretching. A carbon atom fully expands under its diamond state.

Involved typical energy and engaged force to transfer electrons into another carbon state are due to the originally built-in distance of the outer ring. The involved dash-shaped typical energy provides the path to transfer electron for originating a new state of the carbon. The engaged forces only influence in a partial conservative mode and the involved typical energy to transfer the electron also behaves in a partial conservative mode.

A graphite atom is converted into diamond, lonsdaleite and graphene atom by involving the typical energy shaped like dash and engaging the partially conserved force for each transferring electron. A gaseous carbon atom converts into nanotube and fullerene atoms, where the involved typical energy and engaged force for transferring electrons to the positioned unfilled states behave in the same manner as for the case of other states. Energy knots, forming the unfilled and filled states, stretch or tighten depending on the state of carbon atom.

In Figure 1 (i), an electron of filled state transferring to the nearby unfilled state is shown. A dash-shaped typical energy is like a pipe, through which force can see. At one side, dash-shaped typical energy connects with the tip of transferring electron. From the opposite side, it connects with the nearby unfilled state. Hence, electron safely transfers to the unfilled state. Downward arrow indicates increasing potential of the electron and upward arrow indicates decreasing potential of the electron.

An occupied or unoccupied position of the electron in atom is termed as “state”. Based on newly occupied position, transferred electrons originate a new allotropic form of the carbon atom, which is also termed as “state”, but it is related to the atomic state instead of electronic state. Therefore, expansion and contraction of carbon atoms under different states depend on the potential energy and orientation force of the electrons.

3.2. Formation of graphite structure

3.2.1. Formation of graphite structure under the electron dynamics of carbon atoms

Binding of the carbon atoms when they are just ready to attain the graphite state is shown in Figure 2 (a). The ‘Atom A’ has attained the graphite state. The ‘Atom B’ and ‘Atom C’ are in the transition to just attain the graphite state. Two pieces of dash-shaped typical energy are involved to transfer suitable filled state electrons into the nearby suitable unfilled states. The ‘Atom B’ and ‘Atom C’ bind from the both sides of ‘Atom A’. The binding of the atoms is by the involved typical energy.

In the transferring electrons, the exerted forces remain in the partial conservative mode. A nucleation stage of one-dimensional graphite structure is shown in Figure 2 (a). However, upon further binding of the carbon atoms when they are just ready to attain the graphite state, the structure starts to grow. Under the execution of electron dynamics, a graphite structure is nucleated nearly along the same axis, which is shown in Figure 2 (a). A layer of the graphitic structure placing from the rear side is also shown in Figure 2 (a).

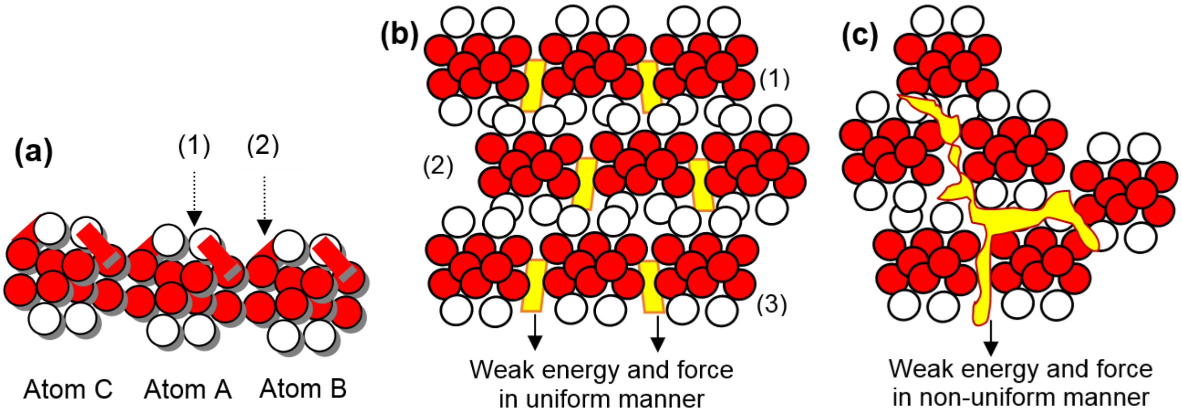


Figure 2: (a) Formation of graphite structure when interstate electron dynamics executed in graphite atoms; (1) unfilled state of transferred electron and (2) involved dash-shaped typical energy. (b) Formation of graphite structure when weak energy contributed under uniformly attained dynamics of graphite atoms. (c) Formation of amorphous graphite structure when weak energy contributed under non-uniformly attained dynamics of graphite atoms

Under the execution of electron dynamics, a graphite structure grows in one dimension, which is along the line of east and west poles. The binding graphite atoms can be from the both sides of X-axis. However, electrons of the bound atoms get their orientation along the same axis, which is also an adjacent orientation. The exerted forces to the electrons along the north-south poles almost diminish. Hence, the structure compels to be termed as one-dimensional structure. In tiny grain carbon film, atoms of arrays elongate by the exertion of surface forces, so they convert into the structures of smooth elements [6].

Typical energy shaped like “dash” is required in transferring the filled state electron to nearby suitable unfilled state. So, the pieces of dash-shaped typical energy get involved to bind graphite atoms under their interstate electron dynamics. In transferring electrons from the left and right sides of the gaseous carbon atom to attain the graphitic state, the potential of the sides transferring electrons from upper states to lower states increases. But the potential remains equalizing in converting the gaseous carbon atom to the graphite state atom. Therefore, that atom maintains the equilibrium in the journey to get the conversion.

3.2.2. Formation of graphite structure under the attained dynamics of graphite atoms

When carbon atoms amalgamate without executing the electron dynamics, they only bind through the attained dynamics. In this case, a dash-shaped typical energy is no more involved in the binding of graphite atoms. The slight difference of forces remains along the east and west poles of just amalgamated graphite state atoms.

A slight difference of the forces between graphite state atoms facilitates to keep them bind. As they were amalgamated only under the attained dynamics, which is shown in the arrays as labeled by (1), (2) and (3) in Figure 2 (b). A weak force resulted from the difference of forces of east-west poles. Therefore, a weak energy remains there keep binding to the graphite state atoms.

Graphite state atoms naturally come into the order of two dimensions. The found force and energy among graphite state atoms together bind them from east-west sides or west-east sides. Force and energy at the atomic level introduce the weak application to preserve the graphite structure. Though the existing force along the opposite poles of the graphite atoms does not work for a greater difference, but it also does not permit the associated energy to separate them. Due to uniformly attained dynamics in graphite state atoms, amalgamated atoms bind under the uniform force and energy.

Forces contribute at the atomic level in attaining the uniform dynamics. So, the energy also contribute at the atomic level in binding the graphite state atoms. The force at the atomic level becomes weaker than the force at the electronic level. The same is the case for energy. Therefore, when graphite state atoms get bound under only attained dynamics, the weak force and the weak energy together contribute in their bindings. Due to orderly amalgamation of graphite state atoms, the force and energy contribute in a uniform manner. Therefore, when the force and energy, chemical in nature, together contribute, a structure related to two dimensions is developed (or formed).

3.2.3. Formation of amorphous graphite structure or amorphous carbon structure

The development (or formation) of an amorphous graphite structure can be anticipated when the amalgamation of graphite state atoms are under the non-uniformly attained dynamics. Atoms do not position exactly from the east-west sides or west-east sides. An amorphous graphite structure is also a more likely the "developed structure" as graphite state atoms do not obey the electron dynamics. In Figure 2 (c), amalgamated atoms bind under the non-uniformly attained dynamics where weak energy and force together contribute. But their contribution is in the non-uniform manner.

A structure of graphite state atoms can also be the amorphous carbon structure when the ground surface is not flat. Force at atomic level contribute in attaining the non-uniform dynamics. So, the energy at atomic level also contributes in binding the graphite state atoms. When the graphite state atoms get bound under only non-uniform attained dynamics, the contributed weak force for them also enables the weak energy to contribute for them.

Due to amalgamation of graphite state atoms without order, force and energy, chemical in nature, contribute in non-uniform manners. Due to non-uniformly attained dynamics in amorphous graphite structure, amalgamated graphite state atoms also bind under the non-uniform force and energy. Therefore, force and energy, chemical in nature, when together contribute in non-uniform manners, an amorphous graphite structure is developed.

3.3. Formation of nanotube and fullerene structures

On converting the carbon atoms into the nanotube state atoms, a nanotube structure is formed. Prior to binding, a nanotube atom can be converted from the fullerene state atom. A fullerene state of the carbon atom converts into the nanotube state atom on transferring the electron to nearby unfilled state of one quadrant and transferring the electron to nearby unfilled state of another quadrant located oppositely. In the conversion, the transferring electrons to the suitable unfilled states are under the involved dash-shaped typical energy. A partial conservative force is engaged in the transfer of electron. Thus, nanotube atoms bind into the structure based on the involvement of partial conservative energy and engagement of partial conservative force. Forces exerted to the electron of one quadrant are engaged in the space and surface formats. Forces exerted to the electron of oppositely sided quadrant are engaged in the surface and grounded formats. In this manner, carbon atom keeps equilibrium during the conversion from one state to another.

A typical energy shaped like dash is involved to transfer the electron. So, carbon atoms having nanotube state can bind to the centered atom having nanotube state, too. Binding of nanotube atoms to the centered nanotube atom from both sides is displayed in Figure 3 (a). This is a nucleation stage of the nanotube structure. The nucleation of nanotube structure can be under two options, which is also shown in Figure 3 (a). In either way, the formation of the structure is two-dimensional. The binding of atoms is not along the same axis. (However, in the electron dynamics of graphite atoms, the binding is along the same line of axis. The formation of structure in graphite atoms is considered one-dimensional.)

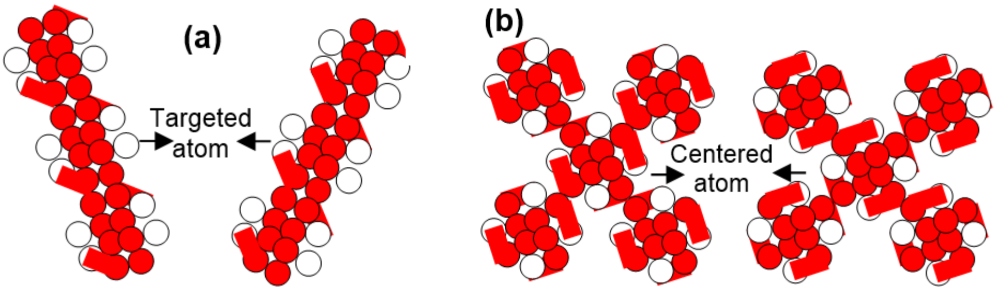


Figure 3: (a) nanotube structure – a two-dimensional structure where the involved typical energy for electrons (of two opposite quadrants) of the targeted nanotube atom binds with the involved typical energy for electrons (of two opposite quadrants) of the two just amalgamated nanotube state atoms and (b) fullerene (buckyballs) – a four-dimensional structure where the involved typical energy for four electrons of the centered fullerene atom binds with the involved typical energy for electrons of the four just amalgamated fullerene state atoms

In the formation of nanotube structure, exertion of forces related to the space and surface formats remained engaged for one electron of the suitable quadrant, whereas exertion of forces related to the surface and grounded formats remained engaged for another electron of the oppositely-sided quadrant. In both cases, the electron dealing with the exertion of forces depends on the manner of linked typical energy for the relevant quadrant, so the behavior of both energy and force in the formation of nanotube structure is partially conserved. The surface format constitutes the force of two poles, i.e., force from the east pole and force from the west pole. So, in each case of the formation of nanotube structure, two forces behave for the exposed sides of the electron, whereas forces of two poles do not behave due to facing the sides of covered typical energy. However, further work is required.

On transfer of electron for each dedicated position, a carbon atom converts into fullerene state atom. Electrons of the outer ring (belonging to all four quadrants) involve typical energy shaped like dash. So, transferring electron of each quadrant engages the partial conservative force along the relevant poles. The engagement of forces is in the space and surface formats for electrons of the two quadrants. The engagement of forces is in the surface and grounded formats for electrons of the remaining two quadrants. An involved dash-shaped typical energy (at the electron level) binds fullerene state atoms for each quadrant of the centred fullerene state atom as shown in Figure 3 (b). The nucleation of fullerene-based structure is also in two different ways, which is shown in Figure 3 (b). Binding of fullerene state atoms to all four quadrants of the 'centered fullerene state atom' nucleates fullerene structure. The structural formation in fullerene state atoms is four-dimensional. The exerting forces along the relevant poles of transferring electrons remain partially conserved.

In the formation of fullerene structure, exertion of forces related to the space and surface formats remained engaged for two electrons of oppositely sided quadrants, whereas exertion of forces related to the surface and grounded formats remained engaged for remaining two electrons of the quadrants. In both cases, two electrons dealing with the exertion of partial conservative forces depends on the manner of covered typical energy. A force in surface format is based on two poles. Therefore, two forces of poles behave for the electron of each quadrant. Due to covering with the typical energy, two forces of poles do not behave for electron of each quadrant. Thus, both energy and force chemical in nature behave partially conserved in the formation of fullerene structure. However, more work is required.

3.4. Formation of diamond structure

A lonsdaleite state atom having ground point just below the ground surface is shown in Figure 4 (a). It reaches to bind the diamond state atom once converted into the diamond state. A carbon atom having diamond state is also shown in Figure 4 (a). The expected binding point of diamond state atoms, when lonsdaleite state atom will convert into the diamond state, is also shown in Figure 4 (a). A diamond state atom deals with the maximum solid state. So, the ground point of diamond state atom remains below the ground point of lonsdaleite state atom. In the nucleation of synthetic diamond, a highly-heated seeded solid surface deals with the deposited atom. Thus, the electrons of a deposited diamond state atom do not further gravitate. Again, due to the maximum achieved potential energy of the electrons, there is no more stretching of their occupied energy knots. Further, electrons do not encroach on the resting surface even to the extent of length of an electron.

A lonsdaleite state atom is converted into the diamond state atom when electrons from the left and right sides transfer to the downward unfilled states. Energy knots clamped electrons in the converted diamond state atom also undertake the same level of stretch as in the case of deposited diamond state atom. On depositing diamond state atom to already deposited diamond state atom, a controlled stretching of energy knots clamped electrons took place. So, the orientationally controlled electrons of depositing atom also in the exertion of forces exert in the surface and grounded formats. All electrons of filled states (in the outer ring) of depositing diamond state atom are in position to undertake one additional clamp of energy knot belonging to all unfilled states (in the outer ring) of deposited diamond state atom as shown in Figure 4 (b).

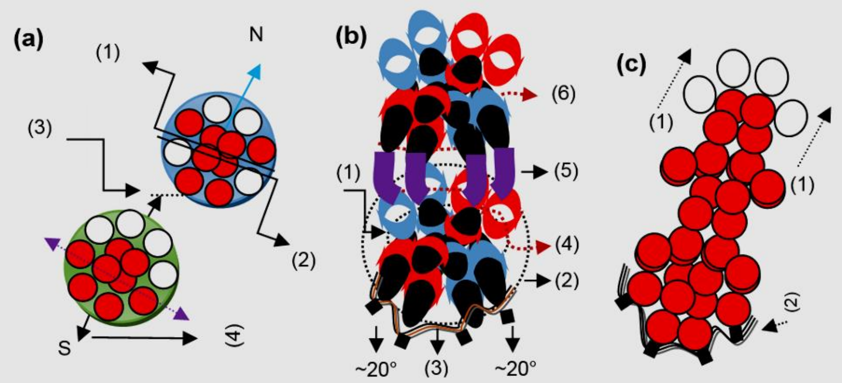


Figure 4: **(a)** Lonsdaleite state atom converting into diamond state atom: (1) east-west poles at ground surface and north pole; (2) ground point of lonsdaleite state atom a bit below the ground surface; (3) expected binding point of the atoms when lonsdaleite state converted into the diamond state; (4) ground point of diamond state atom below the ground surface and south pole. **(b)** Binding of depositing diamond state atom to the deposited diamond state atom: (1) zeroth ring; (2) outer ring; (3) substrate; (4) positioned energy knot; (5) typical energy shaped like golf-stick; (6) targeted electrons. **(c)** South to ground growth of diamond: (1) diamond growth; (2) embedded electrons of the first deposited diamond state atom. (Red circles indicate filled states, white circles indicate unfilled states,

targeted electrons and positioned energy knots are donated by red dotted line arrows in Figure 4b and overlapped red circles indicate double clamping to the electrons)

To undertake another clamp of energy knot by each electron of the outer ring in depositing diamond state atom, left-positioned electron orientates along the left side to the line drawn normal to the center and right-positioned electron orientates along the right side to the line drawn normal to the center. Thus, the orientation of an electron approximately becomes 20° along the south side to the line drawn normal to its center. All four electrons of the outer ring in diamond state atom, west (left) sided two electrons and east (right) sided two electrons obey nearly the same orientation as shown in Figure 4(b). (Orientation of the zeroth ring electrons in diamond state atom got adjusted accordingly.) Atoms of the gaseous and solid states when in the original state behaviors, they keep the orientation of the electrons approximately 40° along the north pole and 40° along the south pole, respectively [3]. In this way, the degree of orientation in electrons of diamond state atom becomes half to the degree of orientation in positioned electrons of gaseous atoms or solid atoms. A typical energy shaped like golf-stick enables the outer ring electrons in depositing diamond state atom to undertake additional clamp of the positioned unfilled energy knot of the outer ring in deposited diamond state atom as shown in Figure 4(b). In the structural formation of diamond, exerting force to each electron also becomes non-conserved.

A growth behaviour of diamond is shown in Figure 4 (c). An adjustment in the stretching of energy-knot-nets takes place at each time of depositing (binding) diamond state atom to deposited (bound) diamond state atom. Therefore, expansion and contraction of the atom is adjusted in the growth of structure. Electrons embedded to substrate surface in the first deposited diamond state atom are also shown in Figure 4 (c). On bearing the maximum stretching of occupied energy knots, electrons aligned ground to south under the non-conservative force. Thus, two diamond state atoms bind from ground to south. This is the nucleation stage of diamond. On binding two diamond state atoms, the third diamond state atom comes into position to bind. On depositing the third diamond state atom, a new point of binding is located under the reference of already adhered two diamond state atoms. In this way, a process of growth in diamond is initiated, which is shown in Figure 4 (c). Therefore, the growth of diamond is south to ground but the binding of diamond state atoms is from ground to south. A binding point in diamond atoms remains between surface format and grounded format (or ground to south). Thus, the structural formation in diamond state atoms is related to the topological structure. The orientation of growing diamond crystal approximately becomes 18° to the normal axis, in Figure 4 (c). Thus, a diamond structure can grow with several faces.

3.5. Formation of lonsdaleite and graphene structures

The ground point of lonsdaleite state atom is a bit below the ground surface as it is below the ground point of graphite state atom. Electrons of lonsdaleite state atom deal with the lower amount of potential energy as compared to electrons of diamond state atom. Hence, the energy knots are in the lesser stretch, so lonsdaleite state atom is in less expansion as compared to the diamond state atom. A lonsdaleite state atom is mainly in a bit solid behavior. In structural formation, a lonsdaleite state atom also experiences the non-conservative force for two electrons under the involvement of non-conserved energy. It is mainly in the surface format and a bit in the grounded format. Thus, lonsdaleite state atoms bind from ground to a bit south, but the growth behaviour is a bit south to ground. However, further studies to investigate the lonsdaleite structure in different carbon-based materials are required.

The ground point of graphene state atom exists just above the ground surface. Electrons of graphene state atoms largely deal with the levitational force. However, the levitational behaviour of force is in non-conserved manner. Binding of graphene state atoms experiences forces mainly in the surface and space formats. So, the growth of graphene structure is opposite to diamond. And the growth of graphene should be ground to north. Principally, graphene state atoms should grow with a topological structure. However, due to the limitation of existing force in the surface format and existing force in the space format, adherence of only a few layers in the graphene structure is possible. Thus, the topological feature in the graphene structure is not observed. In this context, further investigations are required to study not only the binding mechanism in graphene state atoms but the viability of associated forces also.

3.6. Formation of glassy carbon structure

In the structural formation of glassy carbon, three layers of carbon atoms having different state for each layer bind in successive manner. By binding simultaneously, layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms nucleate the structure of glassy carbon. To grow the structure of glassy carbon, layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms bind in the repeated manner. The pieces of typical energy having a shape like golf-stick (or half of parabola) are involved to bind the atoms between the layers.

Layers of gaseous carbon atoms and graphite state atoms bind under the joint application of exerting forces in the grounded format and surface format. The orientationally controlled pair of targeted electrons (of each gaseous carbon atom) undertakes one additional clamping of positionally controlled pair of energy knots (of each graphite state atom) from the rear side as shown in Figure 5. Thus, gaseous carbon atoms attempt a forceful gravitational behavior under the increased potential energy of the electrons.

Layers of lonsdaleite atoms and graphite state atoms bind under the joint application of exerting forces in the space format and surface format. The orientationally controlled pair of targeted electrons (of each lonsdaleite state atom) undertakes one additional clamping of positionally controlled pair of energy knots (of each graphite state atom) from the front side as shown in Figure 5. Hence, lonsdaleite state atoms attempt a forceful levitational behavior under the decreased potential energy of the electrons.

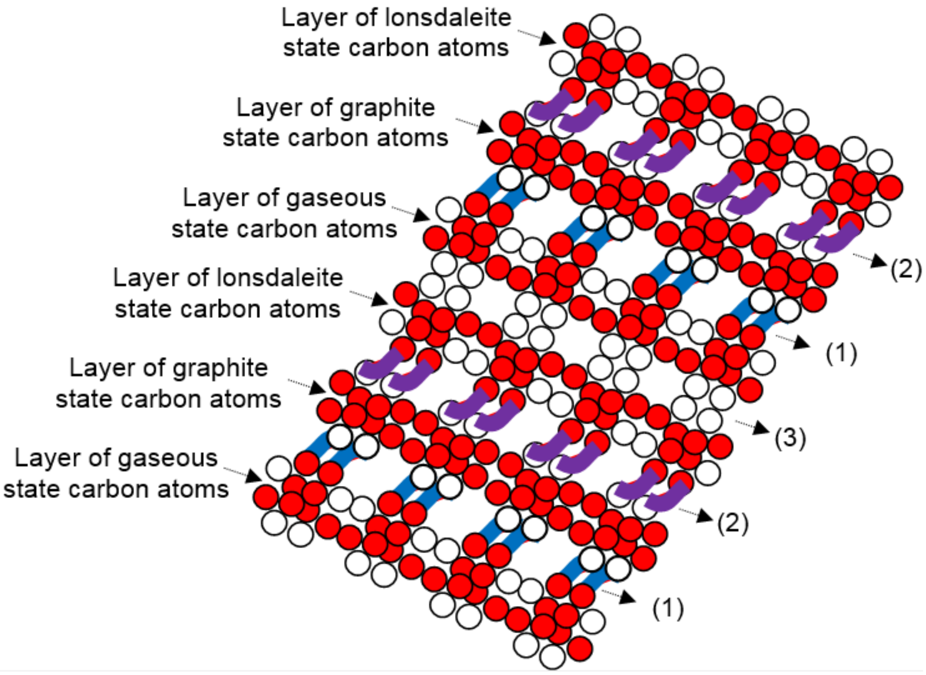


Figure 5: Formation of glassy carbon structure where layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms bind in the successive manner; (1) two electrons of each gaseous carbon atom undertake clamping of energy knots of two unfilled states of each graphite state atom by entering from the rear sides, where typical energy having a shape like golf-stick is involved,

(2) two electrons of each lonsdaleite state atom undertake clamping of energy knots of two unfilled states of each graphite state atom by entering from the front sides, where typical energy having a shape like golf-stick is involved and (3) gaseous and lonsdaleite state atoms compensate expansion and contraction in binding upper and lower layers with the intermediate layer of graphite state atoms; one additional clamping of energy knot to the electron is through the involvement of typical energy shaped like golf-stick

Binding gaseous carbon atoms (of each layer) to the graphite state atoms (of each layer) involves an oppositely J-shaped typical energy (also called golf-stick shaped typical energy), where each pair of electrons (belonging to each gaseous carbon atom) undertakes another clamping of each pair of unfilled energy knot (belonging to each graphite state atom). The clamping of each pair of unfilled energy knot upto the half-length of each pair of electrons is from the rear side. This sort of binding between gaseous carbon atoms and graphite state atoms is shown in (1) of Figure 5.

Binding lonsdaleite state atoms (of each layer) to the graphite state atoms (of each layer) involves a J-shaped typical energy (also called golf-stick shaped typical energy), where each pair of electrons (belonging to each lonsdaleite state atom) undertakes another clamping of each pair of unfilled energy knot (belonging to each graphite state atom). The clamping of each pair of unfilled energy knot upto the half-length of each pair of electrons is from the front side. This sort of binding between lonsdaleite state atoms and graphite state atoms is shown in (2) of Figure 5.

3.7. General discussion

A carbon atom exists in the gaseous state when one electron of the outer ring occupies the state on left side to the north pole and one electron of the outer ring occupies the state on right side to the north pole: the remaining two electrons of the outer ring occupy the states just below the line of east and west poles. A carbon atom is related to graphite state atom when two electrons of the outer ring retain positions at the states occurring just above the line of east and west poles and two electrons of the outer ring retain positions at the states occurring just below that line.

A typical energy shaped like dash involves in transferring filled state electron to unfilled state, where contributing force remains in the partial conservative mode. In the conversion of suitable carbon atom to graphite state, nanotube state or fullerene state atom, two pieces of dash-shaped typical energy involve in transferring the electron from both sides of the atom. The length of a dash-shaped typical energy is equal to the distance between nearby states. The same involved dash-shaped typical energy contributes in the structural formation of graphite, nanotube and fullerene. In the structural formation of graphite, nanotube and fullerene state atoms, the forces are engaged due to the involved partially conserved energy.

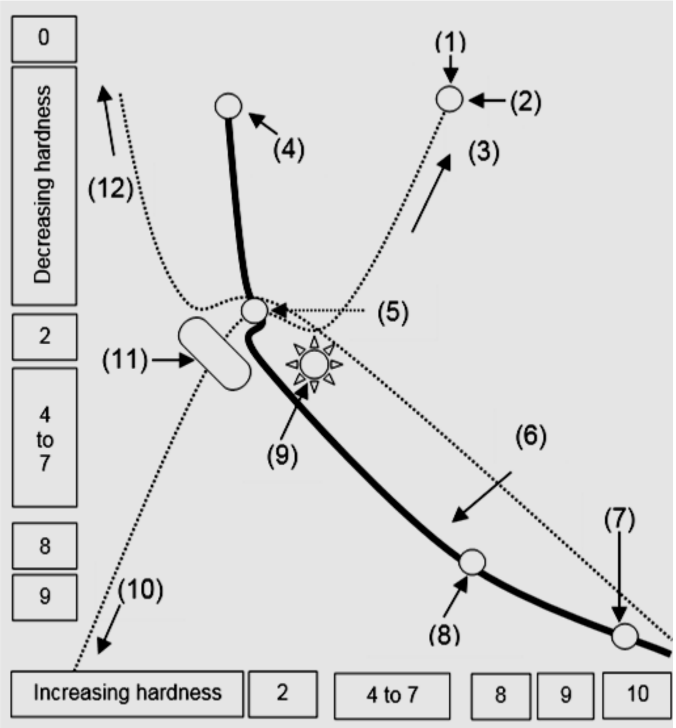
In the conversion of carbon atom to diamond state atom, lonsdaleite state atom or graphene state atom, again a dash-shaped typical energy involves for each side of transferring electron. The engaging forces along the poles of electrons also become partially conserved. However, in the structural formation of diamond, lonsdaleite and graphene, the newly involved golf-stick shaped typical energy largely controls the potential energy of an electron. In this way, the structural formations in diamond, lonsdaleite and graphene state atoms engage the non-conservative forces. In the structural formation of glassy carbon, a non-conservative force is also engaged by the involved non-conservative energy.

In the conversion of gaseous carbon to different states, the involved typical energy engages the force. Here, the word “involve” refers to an action of energy for “instant time”, whereas the word “engage” refers to an action of force for “eternal period”. The “grounded format” implies that the force exerts along the south pole of an electron, whereas the “ground” signifies east-west poles, i.e., surface format, where force exerts along the east-west poles of an electron. When the gaseous carbon atoms are converted into any other state of the carbon, the involvement of typical energy at the first stage is there rather than the partial conservative force. In each carbon atom, electrons of the outer ring execute dynamics. This indicates that atomic radii in different elements along with electronic structure of an atom is the core to elucidate the sort of energy and force which is anticipated for that atom.

In Figure 6, Mohs hardness of different nanostructured and microstructured carbon materials is sketched in estimation. The value of hardness cannot be registered when gaseous carbon atoms are considered. Gaseous carbon atoms do not even form a soft structure, so gaseous carbon atoms keep the hardness zero at Mohs scale. However, in the nanostructures and microstructures of graphite, nanotube and fullerene state atoms, the involvement of partial conservative energy and the engagement of partial conservative forces do not measure the hardness at high scale. However, in the nanostructures and microstructures of lonsdaleite, graphene and glassy carbon, the involvement of non-conservative energy and the engagement of non-conservative forces measure the hardness at high scale. In the

Raman spectroscopy, different values of the wave number vs. energy signals indicate different characteristics of carbon materials [6].

Figure 6: Mohs hardness of nanostructured and microstructured carbon-based materials vs. engaged forces at the electron level; (1) levitational force of the electrons in graphene atoms (ground to north), (2) graphene carbon, (3) increasing levitational force at the electron level, (4) gaseous carbon atoms, (5) graphitic carbon, (6) increasing gravitational force at the electron level, (7) gravitational force of the electrons in diamond atoms (ground to south), (8) lonsdaleite carbon, (9) fullerene carbon, (10) maximally increased gravitational force at the electron level, (11) nanotube carbon , (12) maximally increased levitational force at electron level



The high hardness and very high hardness of nanostructured/microstructured lonsdaleite, graphene and diamond structures are due to the involved typical energy having shape like golf-stick. In the structural formation of hard carbon materials, the typical energy shaped like golf-stick is involved to control the process of undertaking double clamping (of energy knot) by each targeted electron of diamond, lonsdaleite and graphene state atoms. Hence, targeted electrons undertaking double clamping of energy knots engage a non-conservative force in the process. The same is the case in structural formation of glassy carbon, where layers of gaseous, graphite and lonsdaleite state atoms bind successively.

4.0. Conclusion

Carbon atom in its any state does not deal with an impartial (or a neutral) force for an electron. In the conversion of carbon atom from one state to another, energy partially treats the force by involving, and force partially treats the energy by engaging. In electron transfer mechanism of carbon atom, typical energy shaped like dash transfers filled state electron (of outer ring) to nearby unfilled state. A carbon atom instantaneously and simultaneously transfers the electrons of east and west sides to occupy the suitable unfilled states. To attain a new state, a carbon atom maintains equilibrium state by engaging partial conservative force for the transferring electrons.

When the graphite state atoms form two-dimensional structure, it is only under the attained uniform dynamics. In the formation of graphite structure, due to the small difference of forces along the east-west poles, just amalgamated graphite state atoms also involve or engage the weak energy. Weak force and weak energy are contributed together in a uniform manner. In the formation of amorphous graphite structure, graphitic state atoms amalgamate under non-uniformly attained dynamics. But weak force and weak energy are contributed together in non-uniform manner.

A structure of one-dimensional is also formed when the graphite state atoms attain uniform dynamics and execute interstate electron dynamics. In the structural formation of graphite, nanotube and fullerene state atoms, a partially conserved energy gets involved. Hence, a partially conserved force engages in the formation of one-dimensional, two-dimensional and four-dimensional structures, respectively. To nucleate the structure of carbon nanotube, involved energy for the electron of one quadrant and involved energy for the electron of opposite quadrant bind targeted atom with the (partially lateral and partially adjacent) atoms (just amalgamated from the both sides) having also involved energy for the electron of one quadrant and involved energy for the electron of opposite quadrant. To nucleate the structure of carbon fullerene, involved energy for all the four electrons of the outer ring bind targeted atom with the four atoms (just amalgamated from the four sides) having also involved energy for all the four electrons of the outer ring.

A typical energy involved in the diamond, lonsdaleite and graphene state atoms is in non-conservative manner. Each electron of the outer ring (in depositing diamond state atom) takes one additional clamp of energy knot belonging to the outer ring (in deposited diamond state atom). A typical energy shaped like golf-stick is involved in the process of transferring electron upto the half-length. The portion of electron above the clamped energy knot is fully under the exposure of force. The nature of engaged force in bound atoms of topological structures remains also non-conservative.

Binding of diamond state atoms is from ground to south, but growth is from south to ground. Therefore, a structure in the diamond state atoms is a tetra-electron topological structure. Binding of lonsdaleite state atoms is from ground to a bit south, so lonsdaleite state atoms forms a bi-electron topological structure. Therefore, growth behavior of lonsdaleite structure is from south to a bit ground. Binding of graphene state atoms can follow opposite mechanism to that of the diamond state atoms. However, the engaged forces at the electron levels function in the surface and space formats. Though, structure of graphene should be related to the topological structure but the binding atoms up to few layers in graphene do not express largely its topological structure.

Repeated layers of gaseous, graphite and lonsdaleite state atoms grow the structure of glassy carbon. Under the forceful gravitational behavior of electrons, atoms of the gaseous layer bind to the atoms of graphite layer. Due to increased potential energy, electron-pair of each gaseous carbon atom undertakes the additional clamp of energy-knot-pair of each graphite state atom, where golf-stick shaped typical energy involves from the rear side. Under the forceful levitational behavior of electrons, atoms of each lonsdaleite layer bind to the atoms of each graphite layer. Due to decreased potential energy, electron-pair of each lonsdaleite state atom undertakes the additional clamp of energy-knot-pair of each graphite state atom where golf-stick shaped typical energy involves from the front side.

The structural formation in graphite, nanotube and fullerene state atoms is through the partially conserved energy first, and then partially conserved force. In such structural formations, the suitable electrons of atoms execute interstate dynamics by remaining partially confined. On the other hand, in diamond, lonsdaleite and graphene state atoms, structural formation is through the non-conserved energy first, and then non-conserved force. A same is the case in the structural formation of glassy carbon. The property of hardness in carbon-based material should relate to the energy and force, chemical in nature, introducing at the electron level.

In the structural formation of carbon atoms having different states, energy is involved first to engage the force exploring their own science. Carbon atoms enable one to understand the nature of electron dynamics in atoms of different elements. The study of different carbon allotropes opens new areas of investigations, which can enable the understanding of different phenomena existing in the nature.

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