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Article

Atomic Structure and Binding of Carbon Atoms

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Abstract: Many studies discuss carbon-based materials because of the versatility of carbon elements. These studies cover different ideas and discuss them within the scientific scope and application. Depending on the processing conditions of carbon precursors, carbon exists in its various allotropic forms. The electron transfer mechanism is responsible for converting the gaseous carbon atom into the various carbon states named graphite, nanotube, fullerene, diamond, lonsdaleite and graphene. Two pieces of dash-shaped typical energy involve transferring filled state electrons to nearby unfilled states to convert the carbon atom from the existing state to a new state. In an electron transfer mechanism, the carbon atom preserves its equilibrium state. When the pieces of dash-shaped typical energy involve, the electrons of the appropriate filled states instantaneously and simultaneously transfer to the unfilled states. The involved dash-shaped typical energy has its conserved behaviour that is partial. A transferring electron is also under the partially conserved forces. Carbon atoms in graphite, nanotube and fullerene states partially evolve and develop the structures. The structures of one dimension, two dimensions and four dimensions form, respectively. In the formation of such structures, atoms bind under the same pieces of involved dash-shaped typical energy. The graphite structure under the attained dynamics of atoms only is also formed but in two dimensions or amorphous carbon. Here, force and energy, the 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 the electron while undertaking its one additional clamp of energy knot. The involved typical energy has a form like a golf stick. To undertake one additional clamp of energy knot, all four electrons of the outer ring in the depositing diamond state atom get aligned along the south pole, and all four unfilled energy knots of the outer ring in the 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 the ground to the south. Growth is from south to ground, so the structure of diamond is a tetra-electron topological structure. The binding of lonsdaleite state atoms is from the ground to a bit south. However, in glassy carbon, the layers of gaseous, graphite and lonsdaleite state atoms bind simultaneously. The order of these layers repeats in the growth process of glassy carbon. The Mohs hardness in different carbon materials is also sketched.

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

1.0. . Introduction

New strategies are required to process and synthesize carbon-based materials in selective sizes. A new science at both primary and applied levels can be explored in the characterizations and analyses of carbon-based materials. 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, force and energy, a chemical in nature, should together contribute.

The involved energy at the electron level should direct the engaged force at the electron level. The same can be the case for atoms and nano-objects. 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. 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 close filled and unfilled states to the centre of the carbon atom, electrons of the outer rings do not deal with the conservative force. The relation of energy and force in such atoms should be either in the partially conserved mode or in the non-conserved mode. It can depend on the state of a carbon atom. Carbon has different states, known in the allotropes, i.e., starting from the gaseous state to graphite state, then diamond state, lonsdaleite state, and fullerene state, followed by the nanotube state, graphene state, and finally glassy carbon. In the literature, several studies have mentioned these states.

When the conservative forces exert on the electron in a silicon atom, an uninterrupted execution of its dynamics generates a photon of unending length [2]. It indicates that the built-in interstate gap of electron dynamics in the carbon atom differs from silicon. Both carbon and silicon atoms possess equal numbers of filled and unfilled states in the outer ring. However, electrons of the outer ring in the carbon atom display different distances from the electrons of the outer ring in the silicon atom. A silicon atom keeps the zeroth, first, and outer, but a carbon atom keeps only the zeroth and outer rings [3]. An electron transfer mechanism should be different when converting a carbon atom to another state. The atoms of those elements executing confined interstate electron dynamics 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 processing conditions, carbon atoms deposit in different morphology and structure of grains and crystallites [7]. Different grains and particles morphology resulted at different chamber pressures identifying the role of specific energy binding the atoms [8]. The deposition of graphite and diamond in different regions of the single substrate is due to different inter-wire distances [9]. Different carbon-based materials contain atoms of the same element but specify different behaviours in their analysis [6-9]. Thus, the electron transfer mechanism is responsible for changing an atom's chemical nature regardless of whether it belongs to the same element.

The force entering from the north pole and leaving the ground surface for the south pole behaves differently than 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 without a catalyst using a vapour deposition method [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]. In their comparison, different carbon allotropes were studied for dehydrogenation of temperature [17]. 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 a 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 carbon nanocones' elastic and failure properties through molecular dynamics simulation. Levitated nanodiamonds burn in the air because of amorphous carbon on their surfaces, and they deal with uncertainty in the measurement of their temperature [24]. It removes uncertainty in the temperature measurement of levitated nanodiamonds, which paves the way for numerous applications [25].

A layout of the atomic structure in different states of the carbon atoms is not clear along with the binding mechanism in identical state carbon atoms. The nature of force and energy behaviour in electron transfer mechanism and in binding the same state carbon atoms is discussed here. The formation mechanism of glassy carbon is also unclear. 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 has been discussed by enormous publications. Several techniques and methods are depositing and synthesizing carbon materials can be referred from the studies given in the reference list and literature.

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

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

3.0. Results and Discussion

3.1. Structures of different states of carbon atoms

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

The precisely intercrossed overt photons shape energy knots related to filled and unfilled states. Overt photons keep equal lengths. The lengths of the overt photons are so that their schedule crossing shapes the filled and unfilled states required to construct the 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. It is shown in Figure 1 (a).

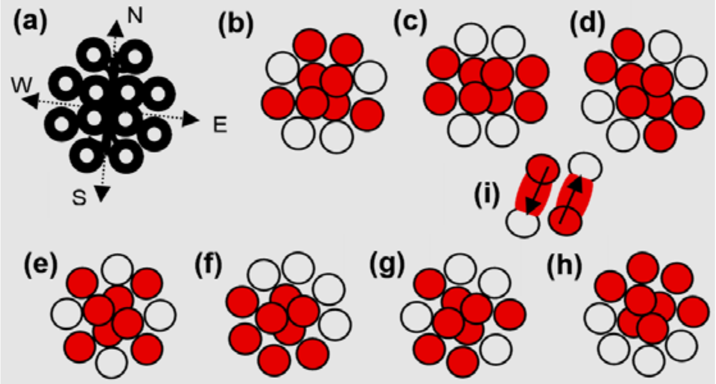

Figure 1. (a) Lattice of a carbon atom. Atomic structure of carbon atom in the (b) gaseous state, (c) graphite state, (d) nanotube state, (e) fullerene state, (f) diamond state, (g) lonsdaleite state, (h) graphene state and (i) electron transferring to downward state and electron transferring to upward state; red circles indicate filled states, and white circles indicate unfilled states (sketch is drawn in estimation).

In the formation or construction of carbon lattice, two energy knots from each side of the centre remained compressed. It is due to the presence of surrounding states. In this way, eight states are shaped, forming the outer ring in a carbon atom. Four states are related to the filled states, and four 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 the carbon atom is also shown in Figure 1 (a).

The lattice of a carbon atom is related to the energy-knot-net, as shown in Figure 1 (a). The trough of one comes in front of the crest of the other when the intercrossed overt photons form or construct the shape of a carbon lattice. The overt photons preserve their force by wrapping the energy [2].

In the gaseous carbon atom, four energy knots of the outer ring are filled. The electrons also fill the states belonging to the zeroth ring. 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-centred electrons form the zeroth ring. The zeroth ring is related to the helium atom [3]. In Figure 1, the atomic structure of carbon has different states, 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 were transferred to originate a new carbon atom state. In migrating electrons from the 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 behaviour. The typical energy shaped like a 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 into different states, one electron from the 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 the graphite atom convert it into the lonsdaleite atom. Dash-shaped typical energy along the west to south and dash-shaped typical energy along the east to the south get involved. The exerted forces on the transferring electrons remain partially conserved, related to the surface and grounded formats. During the conversion of graphite atom into lonsdaleite atom, only two electrons are transferred to the nearby positioned unfilled states. Two electrons are transferred to the nearby positioned unfilled states to convert the lonsdaleite atom into the diamond atom. The ground point in the diamond atom goes further below the ground surface than 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. Partial conservative energy gets involved, and 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 electrons for originating a new state of 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 a 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 in the case of other states. Energy knots, forming the unfilled and filled states, stretch or tighten depending on the state of a carbon atom.

Figure 1 (i) shows an electron of a filled state transferring to the nearby unfilled state. Dash-shaped typical energy is like a pipe through which force can see. On 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, the electron safely transfers to the unfilled state. The downward arrow indicates the increasing potential of the electron, and the upward arrow indicates decreasing the potential of the electron.

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

3.2. *Formation of graphite structure*

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

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

The exerted forces remain in the partial conservative mode in the transferring electrons. A nucleation stage of a 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 electron dynamics, a graphite structure is nucleated nearly along the same axis, shown in Figure 2 (a). A layer of the graphitic structure placed from the rear side is also shown in Figure 2 (a).

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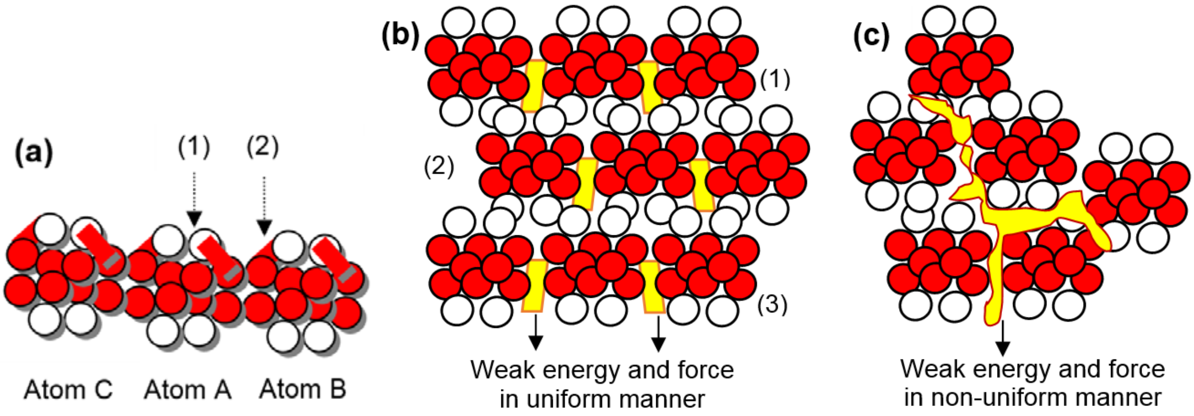

Figure 2. (a) Formation of graphite structure when interstate electron dynamics are executed in graphite atoms; (1) unfilled state of a transferred electron; and (2) involved dash-shaped typical energy. (b) Formation of graphite structure when weak energy contributed under uniformly attained dynamics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

Under electron dynamics, a graphite structure grows in one dimension along the east and west poles. The binding graphite atoms can be from both sides of the X-axis. However, electrons of the bound atoms get their orientation along the same axis, which is also an adjacent orientation. The exerted forces on the electrons along the north-south poles almost diminish. Hence, the structure compels to be termed a 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 a dash is required to transfer the filled state electron to a nearby unfilled state. So, the pieces of dash-shaped typical energy get involved in binding graphite atoms under their interstate electron dynamics. To transfer electrons from the left and right sides of the gaseous carbon atom in attaining the graphitic state, the sides' potential to transfer electrons from upper states to lower states increases. However, the potential in converting the gaseous carbon atom to the graphite state atom remains equal. 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, 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 in the forces between graphite state atoms facilitates keeping them bound as they were amalgamated only under the attained dynamics, which is shown in the arrays as labelled by (1), (2) and (3) in Figure 2 (b). A weak force resulted from the difference of forces of the east-west poles. Therefore, weak energy remains and keeps 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 bind them from east-west 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 more significant difference, it 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 to attaining uniform dynamics. So, the energy also binds the graphite state atoms at the atomic level. 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 are bound under only attained dynamics, the weak force and the weak energy contribute to their bindings. Due to the orderly amalgamation of graphite state atoms, the force and energy contribute uniformly. Therefore, when the force and energy, a 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 of an amorphous graphite structure can be anticipated when the amalgamation of graphite state atoms is 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 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 contribute. However, their contribution is in a 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 the atomic level contributes to attaining the non-uniform dynamics. So, the atomic level energy also contributes to binding the graphite state atoms. When the graphite state atoms get bound under only non-uniform attained dynamics, the contributed weak force also enables the weak energy to contribute to them.

Due to the amalgamation of graphite state atoms without order, force and energy, a 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, a chemical in nature, when together contribute in non-uniform manners, an amorphous graphite structure is developed.

3.3. Formation of nanotube and fullerene structures

A nanotube structure is formed by converting the carbon atoms into the nanotube state atoms. A nanotube atom can be converted from the fullerene state atom before binding. A fullerene state of the carbon atom converts into the nanotube state atom by transferring the electron to the nearby unfilled state of one quadrant and transferring the electron to the nearby unfilled state of another quadrant located oppositely. The transferring electrons to the appropriate unfilled states are under the involved dash-shaped typical energy in the conversion. A partial conservative force is engaged in the transfer of electrons. 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 the oppositely-sided quadrant are engaged in the surface and grounded formats. In this manner, the carbon atom keeps equilibrium during the conversion from one state to another.

Typical energy shaped like a dash is involved in transferring the electron. So, carbon atoms having a nanotube state can bind to the central atom having a nanotube state. The binding of nanotube atoms to the centered nanotube atom from both sides is shown in Figure 3 (a). It is a nucleation stage of the nanotube structure. The nucleation of the nanotube structure can be under two options, which are also shown in Figure 3 (a). 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 axis line. The formation of structure in graphite atoms is considered one-dimensional.)

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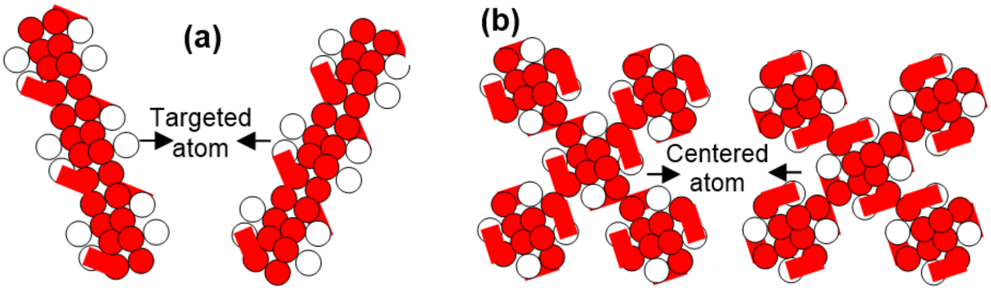

Figure 3. (a) nanotube structure – a two-dimensional structure where the involved typical energy for electrons (of two opposite quadrants) of the targeted nanotube atom binds with the involved typical energy for electrons (of two opposite quadrants) of the two just amalgamated nanotube state atoms and (b) fullerene (buckyballs) – a four-dimensional structure where the involved typical energy for four electrons of the centred 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 right 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 behaviour 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., the force from the east and west poles. 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.

A carbon atom converts into a fullerene state atom on electron transfer for each dedicated position. Electrons of the outer ring (belonging to all four quadrants) involve typical energy shaped like a dash. So, transferring the 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 the fullerene-based structure is also different, as shown in Figure 3 (b). In nucleating the structure, the fullerene state atoms bind to all four quadrants of the centred fullerene state atom. 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, 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 the remaining two electrons of the quadrants. In both cases, two electrons dealing with the exertion of partial conservative forces depend 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 poles' forces do not behave for the electron of each quadrant. Thus, both energy and force, a chemical in nature, behave partially conserved in forming a fullerene structure. However, more work is required.

3.4. *Formation of a diamond structure*

A lonsdaleite state atom having a 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 a diamond state is also shown in Figure 4 (a). The expected binding point of diamond state atoms, when the lonsdaleite state atom will convert into the diamond state, is also shown in Figure 4 (a). A diamond atom deals with the maximum solid behavior. So, the ground point of the diamond state atom remains below the ground point of the 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 the length of an electron.

A lonsdaleite 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 stretch level as the deposited diamond state atom. A controlled stretching of energy knots clamped electrons took place when depositing the diamond state atom to an already deposited diamond state atom. So, the orientationally controlled electrons of depositing atom also in the exertion of forces exerted in the surface and grounded formats. All electrons of filled states (in the outer ring) of depositing diamond state atom are in a 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).

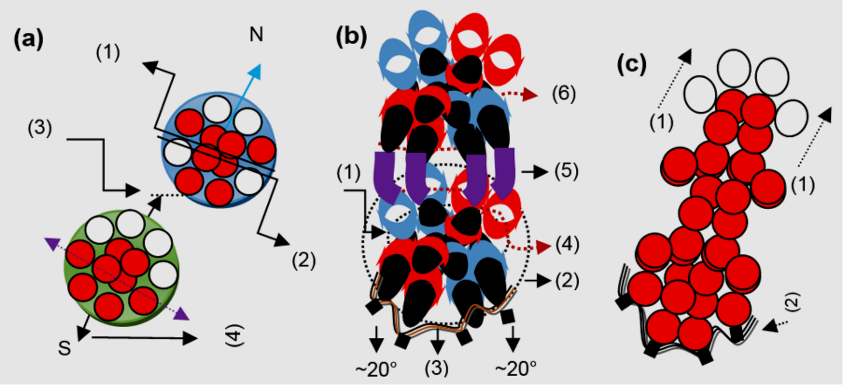

Figure 4. (a) Lonsdaleite state atom converting into diamond state atom: (1) east-west poles at the ground surface and north pole; (2) ground point of lonsdaleite state atom a bit below the ground surface; (3) expected binding point of the atoms when lonsdaleite state converted into the diamond state; (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).

In another clamping of energy knot by all outer ring electrons in depositing diamond state atom, the left-positioned electrons orientate along the left side to the line drawn normal to the centre, and the right-positioned electrons orientate along the right side to the line drawn normal to the centre. Thus, the orientation of an electron becomes ~ 20° along the south side to the line drawn normal to its centre. All four electrons of the outer ring in the 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 the diamond state atom got adjusted accordingly. Atoms of the gaseous and solid states, when in the original state behaviours, keep the orientation of the electrons ~ 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 atoms becomes half of the degree of orientation in positioned electrons of gaseous atoms or solid atoms. Typical energy shaped like a 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 on each electron also becomes non-conserved.

The growth behavior of diamonds is shown in Figure 4 (c). An adjustment in the stretching of energy-knot-nets occurs at each time of depositing (binding) diamond state atom to deposited (bound) diamond state atom. Therefore, the expansion and contraction of the atom are adjusted in the growth of the structure. Electrons embedded in the 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 the ground to the south under the non-conservative force. Thus, two diamond state atoms bind from ground to south. It is the nucleation stage of a 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 growth process in diamonds is initiated, shown in Figure 4 (c). Therefore, the growth of diamond is south to the ground, but the binding of diamond state atoms is from ground to south. The binding of diamond atoms remains between the surface and grounded formats, i.e., ground to the south. Thus, the structural formation in diamond state atoms is related to the topological structure. The orientation of the 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 the lonsdaleite state atom is a bit below the ground surface as it is below the ground point of the graphite state atom. Electrons of the lonsdaleite state atoms have lower potential energy than electrons of the diamond state atom. Hence, the energy knots are in the lesser stretch, so the lonsdaleite state atom is less expanded than the diamond state atom. A lonsdaleite state atom is mainly in a bit solid behaviour. 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 the ground to a bit south, but the growth behaviour is from (a bit) south to the ground. However, further studies investigating the lonsdaleite structure in different carbon-based materials are required.

The ground point of the graphene state atom exists just above the ground surface. Electrons of graphene state atoms primarily deal with the levitational force. However, the levitational behaviour of force is in a non-conserved manner. The binding of graphene state atoms experiences forces mainly in the surface and space formats. So, the growth of graphene structure is opposite to diamond.

Moreover, the growth of graphene should be ground to the 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 to only a few layers in the graphene structure is possible. Thus, the topological feature in the graphene structure is not observed. Further investigations are required to study the binding mechanism in graphene state atoms and the viability of associated forces.

3.6. *Formation of glassy carbon structure*

In glassy carbon, three layers of carbon atoms having different states for each layer bind successively. By binding simultaneously, layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms nucleate the glassy carbon structure. To grow the glassy carbon structure, layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms bind repeatedly. The pieces of typical energy shape like a golf stick or half of a parabola are involved in binding the atoms between the layers.

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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 the 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 an aggressive gravitational behaviour under the increased potential energy of the electrons.

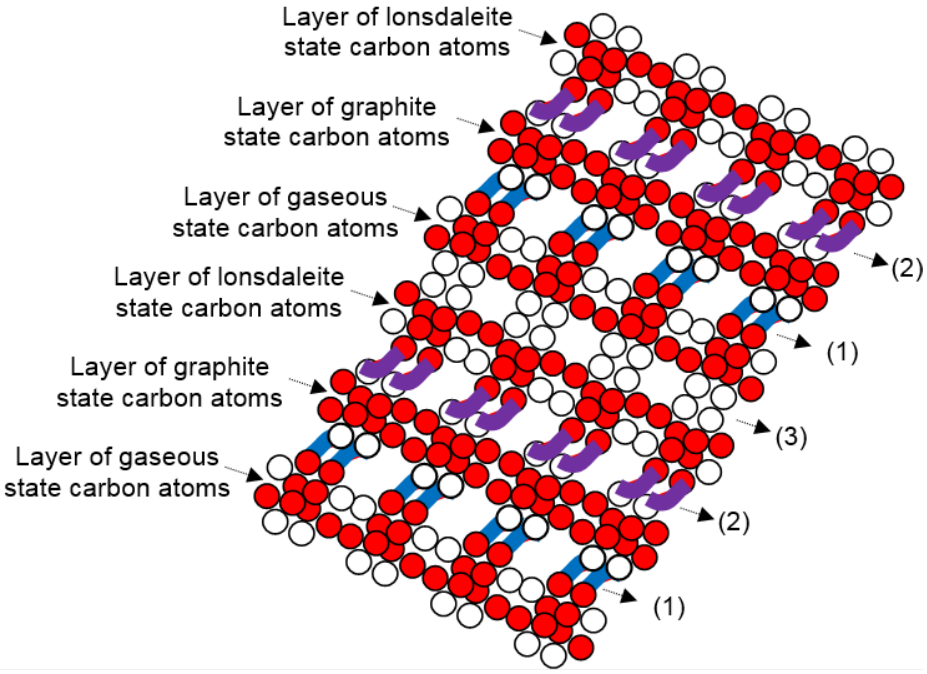

Figure 5. Formation of glassy carbon structure where layers of gaseous carbon atoms, graphite state atoms and lonsdaleite state atoms bind successively; (1) two electrons of each gaseous carbon atom undertake clamping of energy knots of two unfilled states of each graphite state atom by entering from 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.

Layers of lonsdaleite atoms and graphite state atoms bind under the joint application of exerting forces in space and surface formats. 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 an aggressive levitational behaviour under the decreased potential energy of the electrons.

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 knots to the half-length of each pair of electrons is from the rear side. This 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 J-shaped typical energy, also called golf-stick-shaped typical energy. Each pair of electrons belonging to each lonsdaleite state atom undertakes another clamping of each pair of unfilled energy knots belonging to each graphite state atom. The clamping of each pair of unfilled energy knots to the half-length of each pair of electrons is from the front

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side. This binding between lonsdaleite state 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 the left side of the north pole, and one electron of the outer ring occupies the state on the right side of 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 a graphite state atom when two electrons of the outer ring retain positions at the states occurring just above the east and west poles, and two electrons of the outer ring retain positions at the states occurring just below that line.

Typical energy shaped like dash involves transferring filled state electron to unfilled state, where contributing force remains in the partial conservative mode. In converting a suitable carbon atom to a graphite state, nanotube state or fullerene state atom, two pieces of dash-shaped typical energy are involved in transferring the electron from both sides of the atom. The distance between nearby states equals the length of dash-shaped typical energy. The same involved dash-shaped typical energy contributes to graphite's structural formation, 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 converting carbon atom to diamond state atom, lonsdaleite state atom or graphene state atom, typical dish-shaped energy involves 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 essentially 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 non-conservative energy.

In converting gaseous carbon to different states, the involved typical energy engages the force. Involve indicates energy for an instant time, whereas engage indicates force for the 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. It indicates that atomic radii in different elements and the electronic structure of an atom are the core to elucidate the energy and force anticipated for that atom.

In Figure 6, the Mohs hardness of different nanostructured and microstructured carbon materials is an 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 the 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 a large 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 a large scale. In Raman spectroscopy, different wavenumber values vs energy signals indicate different characteristics of carbon materials [6].

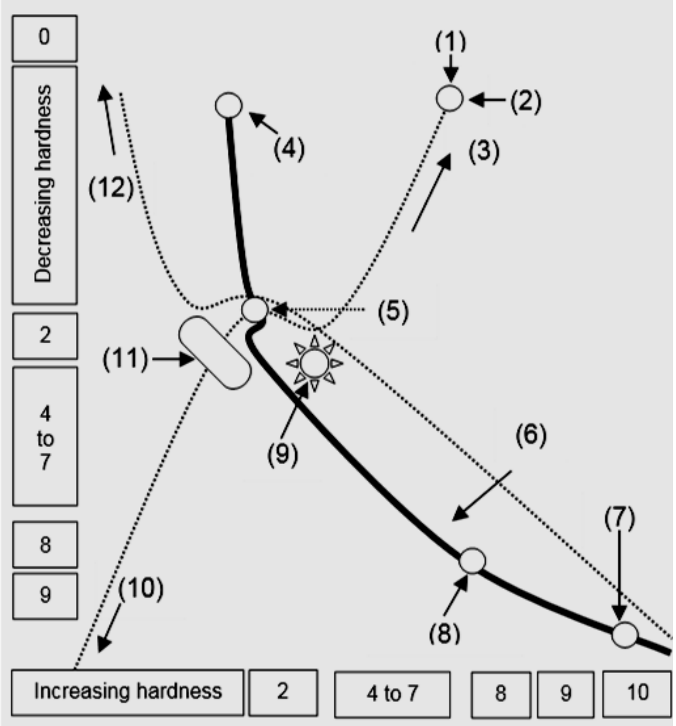

Figure 6. Mohs hardness of nanostructured and microstructured carbon materials vs engaged forces at the electron level; (1) levitational force of the electrons in graphene atoms (ground to the north), (2) graphene carbon, (3) increasing levitational force at the electron level, (4) gaseous carbon atoms, (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 the electron level .

The high hardness of nanostructured and microstructured lonsdaleite, graphene, and diamond materials is due to a golf stick's typical energy shape. In the structural formation of hard carbon materials, the typical energy shaped like a golf stick is involved in controlling 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. The same is the case in the structural formation of glassy carbon, where layers of gaseous, graphite and lonsdaleite state atoms bind successively.

4.0. . Conclusion

A carbon atom in its state does not deal with an impartial or a neutral force for an electron. In converting carbon atoms from one state to another, energy partially treats the force by involving, and force partially treats the energy by engaging. In the electron transfer mechanism of the 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 the east and west sides to occupy the appropriate unfilled states. A carbon atom maintains an equilibrium state by engaging partial conservative force for the transferring electrons to get a new state.

When the graphite state atoms form a two-dimensional structure, it is only under the attained uniform dynamics. In the formation of graphite structure, due to the slight 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 uniformly. In the formation of amorphous graphite structure, graphitic state atoms amalgamate under non-uniformly attained dynamics. However, weak force and weak energy are contributed together in a non-uniform manner.

The one-dimensional structure is also formed when the graphite state atoms attain uniform dynamics and execute interstate electron dynamics. Partially conserved energy gets involved in the structural formation of graphite, nanotube and fullerene state atoms. Hence, a partially conserved force gets engaged 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 both sides) having also involved energy for the electron of one quadrant and involved energy for the electron of an opposite quadrant. To nucleate the structure of carbon fullerene, involved energy for all the four electrons of the outer ring bind the 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.

Typical energy in the diamond, lonsdaleite and graphene state atoms is non-conservative. 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). Typical energy shaped like a golf stick is involved in transferring electrons up to the half-length. The portion of the electron above the clamped energy knot is entirely under the exposure of force. The nature of engaged force inbound atoms of topological structures also remains non-conservative.

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

Repeated layers of gaseous, graphite and lonsdaleite state atoms grow the glassy carbon structure. Under an aggressive gravitational behaviour of electrons, atoms of the gaseous layer bind to the atoms of the graphite layer. Due to increased potential energy, the 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 behaviour of electrons, atoms of each lonsdaleite layer bind to the atoms of each graphite layer. Due to decreased potential energy, the 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 confined partially. 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. The same is the case in the structural formation of glassy carbon. The hardness property in carbon-based material should relate to the energy and force, chemical in nature, introduced at the electron level.

In the structural formation of carbon atoms having different states, energy is involved first to engage the force in exploring their 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 investigation, which can enable the understanding of different phenomena in nature.

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Data Availability Statement: This work is based on the fundamental nature of science.

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Mubarak Ali graduated from University of the Punjab with BSc (Phys & Math) in 1996 and MSc in Materials Science with distinction from Bahauddin Zakariya University, Multan, Pakistan (1998); his thesis work was completed at Quaid-i-Azam University Islamabad. He gained a Ph.D. in Mechanical Engineering from the Universiti Teknologi Malaysia under the award of the Malaysian Technical Cooperation Programme (MTCP;2004-07) and a postdoc in advanced surface technologies at Istanbul Technical University under the foreign fellowship of The Scientific and Technological Research Council of Turkey (TÜBİTAK, 2010). Dr. Mubarak completed another postdoc in nanotechnology at the Tamkang University Taipei, 2013-2014, sponsored by National Science Council, now M/o Science and Technology, Taiwan (R.O.C.). Presently, he is working as an Assistant Professor on the tenure track at COMSATS University Islamabad (previously known as COMSATS Institute of Information Technology), Islamabad, Pakistan (since May 2008, and the position renewal is in the process) and prior to that, worked as assistant director/deputy director at M/o Science & Technology (Pakistan Council of Renewable Energy Technologies, Islamabad, 2000-2008). The Institute for Materials Research, Tohoku University, Japan, invited him to deliver a scientific talk. He gave several scientific talks in various countries. His core area of research includes materials science, physics & nanotechnology. He was also offered a merit scholarship for the Ph.D. study by the Higher Education Commission, Government of Pakistan, but he did not avail himself of the opportunity. He earned a diploma (in English) and a certificate (in the Japanese language) in 2000 and 2001, respectively, part-time from the National University of Modern Languages, Islamabad. He is the author of several articles available at the following links; https://www.researchgate.net/profile/Mubarak_Ali5 & https://scholar.google.com.pk/citations?hl=en&user=UYjvhDwAAAAJ