Forcing or Forced Exertions in Amalgamation of Nanoparticles and Particles inside the Solution

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Abstract: The study of forcing or forced exertions in amalgamating or amalgamated nanoparticles and particles inside the solution is important for the scientific societies working in the fields of physical, chemical and mathematical sciences. Observing live dynamics of nanoparticles and particles inside the solution is a challenging task. Again, it is not an appropriate way to discuss amalgamating nanoparticles and particles based only on visualized dynamics. However, suitably captured microscopic images can identify different modes of forcing or forced exertions in amalgamated nanoparticles and particles. Nanoparticles and particles when just at resting positions amalgamate under resultant differences of exerting forces, which are not only related to poles of occupied quadrants, but also related to their own drawn poles. So, colloidal nanoparticles and particles amalgamate from sides experiencing a greater exertion of force. In amalgamation of nanoparticles and particles, the exerted force successively remains in mute, alert and functioning mode. Contrarily, the energy behavior successively remains in functioning, alert and mute mode. Amalgamation of nanoparticles and particles depends on their features and conceived focusing lengths. This is through the resultant differences of exerting forces for two frame of references. Particles of geometrical shapes experience the even exertions of force in their amalgamation, which is not the case for distorted particles. Nanoparticles and particles inside the solution are the best candidates to track nature of exerting forces, and so is the case with energy behaviors, too.

Keywords: Nanoparticles; Particles; Forcing exertion; Forced exertion; Suspected point; Focusing length; Amalgamation; Agglomeration

1. Introduction

In order to understand the atomic behavior in different elements, a mechanism of forcing or forced exertion at electron level can be considered. The exertion of force at electron level in atoms of all elements can be considered naturally in action. This will lead to the understanding of forcing and forced behaviors of nanoparticles and particles while their amalgamations inside the solution. It is possible to trace dynamics of amalgamating nanoparticles and particles under the study of suitably captured microscopic images.

Exertion to an atom executing confined inter-state electron dynamics involves a conservative mode of force at first stage [1]. A silicon atom under neutral state executes confined inter-state electron dynamics to generate photon energy shaped like a wave [2]. In electron transfer mechanism of a gaseous carbon atom, energy and force together convert state behavior as explored by Ali [3]; a conversion of gaseous carbon atom into different states is through the engagement (not involvement) of a non-conservative force, which is at second place, and where non-conserved energy is involved (not engaged) at first stage. The study conducted by Ali [4] discussed that engaged forces to influence electrons of gaseous atoms or solid atoms are through suitable amount of supplied energy. Thus, they introduced different transitional behaviors, and then atoms of none of the elements ionize [5].

Tiny particles of different features developed through the application of energy and force under different behaviors [6]. To nucleate geometric-shaped nanoparticles and particles through the coalescences of tiny particles, exerting forces in the immersing format were considered vital by Ali and Lin [7]; exerted forces in the development of tiny particles in different zones of solution surface were studied, and a source of levitational force was explored. Visualizing and observing the atoms at work, their charge dynamics were studied by the application of high-resolution microscopy [8, 9].

Gold particles of different shapes were developed under varying precursor concentration [10]. Morphology and structure of gold tiny particles and larger particles

were controlled by varying the pulse OFF to ON ratio under bipolar mode [11]. The origin of physics and chemistry of materials was discussed, where particles of extended shapes developed at a very high rate [12]. Unprecedentedly-shaped colloidal particles were developed discussing the predictor packing of triangular shaped tiny particles [13]. A different structure in silver colloids and gold colloids emerged synthesizing for nearly identical conditions of the process [14]. In addition to this, studies referred in references 10-14 also show initial efforts for studying mechanisms of different forcing or forced exertions. However, this work presents the mechanism of forcing or forced exertions in amalgamating or amalgamated nanoparticles and particles.

It is important to understand the individual dynamics of formation of tiny particles before studying assembling for a larger particle [15]. Understanding coalescence of tiny particles for a larger particle will enable to deal with atoms and molecules as materials of tomorrow [16].

The on-going research efforts should also use dynamics in addition to geometry and entropy to explain the structure [17]. Park *et al*. [18] introduced a method to determine three-dimensional structure of individual nanoparticles in solution as they tend to be a useful means of information. The modification of building blocks to some extent introduced a complexity in their self-assembled structures [19]. Reaction-diffusion processes at the nano- and microscales were investigated providing new means of understanding in different areas [20]. Tuma *et al.* [21] exploited the physics of reversible phase transition from amorphous to crystal state where that was under the reset of neuron reconfiguration of atomic structure. The optical properties of vanadium dioxide changed intensely under the change in state [22]. To configure colloidal assembly, the procedure of multiple laser beams may manipulate and assemble colloidal atoms in parallel form [23]. A detailed analysis was presented for complex nano-structures and colloidal nanoparticles under the description of different named forces [24]. Different interactions were considered in the formation of a variety of nanoparticles [25, 26].

An understanding in the forcing and forced behaviors while amalgamation of nanoparticles and particles will help to also understand the energy behavior at micro, nano, atomic and electron level. Some recent studies considered force discussing the results of an adhesive performance of graphene/shape memory polymer [27], a basic

mechanism of understanding the interaction between inorganic and organic nanomaterial [28], and toxicity in different gold clusters under various concentrations [29].

Various chemical compounds and precursors are used to develop a variety of nanoparticles and particles. In different methods, the set conditions also introduce forcing exertions through medium dynamics in addition to exertions of forces of their own poles drawn from nanoparticles and particles at resting positions. Nanoparticles and particles amalgamate or aggregate for different zones inside the solution to scheme stalls or agglomerates. Their modes of amalgamation identify the new parameters which have not yet been investigated or have been investigated in lesser details. Dynamics describe their behavior at all scales; dynamics identify locally arisen forces in relation to fundamental forces. The amalgamation of nanoparticles and particles in suitable zones of solution is discussed, where they exhibit agglomerations of captured microscopic images. Here, forcing and forced exertions to nanoparticles and particles while amalgamation are discussed. The study of energy behavior for them is worked out analogously. For this, bright field transmission microscopic images of nanoparticles and particles are chosen; a development process of those nanoparticles and particles was discussed in various studies employing pulse-based electron-photon/solution interface process [10-13].

2. Results and Discussion

A tiny particle of geometrical or non-geometrical shape is in the side length of a few atoms. A molecule is smaller in size or of the same size as a tiny particle. A nanoparticle has length of each side in a few tens of nanometers. So, it is bigger in size than a tiny particle. This way, a particle has a length of each side in several tens of nanometers. In different sizes of range, all sorts of tiny particles, nanoparticles and particles are related to colloidal entities.

On development, nanoparticles and particles fill the spaces available among them through amalgamation inside the solution. Developing nanoparticles and particles occupy different zones inside the solution depending on the conditions of their processing. Prior to amalgamating when at rest even for an instant, they undergo amalgamation through tracing functioning different forcing exertions. The noticeable

space between them depends on several factors such as composition, dimension of beaker, positions of source dynamics, input power, the nature of ingredients and a surrounding environment, processing time, distribution density and overall features of nanoparticles and particles, etc. Both density and distribution of nanoparticles and particles influence the rate of amalgamation. But the rate of amalgamating nanoparticles and particles can be controlled by choosing their selective size and shape. Particles can collide and attach under Brownian motion, laminar or turbulent flow or relative particle setting mechanism to show their agglomeration [30].

A harmonized lateral width in nanoparticles and particles can facilitate to fill vacant spaces available among them. Here, a controlled orientation of amalgamation gives rise to a new shape of their distribution. A nanoparticle or particle of geometrical shape is influenced by a force having a directional behavior. When a similar shaped nanoparticle or particle conceived the focusing of length coming within the common vicinity, it amalgamated under the even exertion of force at electron level. Focusing of size distributions in colloidal nanocrystals was first pointed out by Peng *et al.* [31]. Size focusing methodology is due to the different levels of stability among different-sized nanoparticles [32]. Hannah *et al*. [33] demonstrated size refocusing to order phase in gold-copper nanoparticles.

Input parameters along with the set-up of developing nanoparticles and particles shown in Figures 1, 2 & 3, 4 and 5 are given in the references 10, 11, 12 and 13 respectively.

In Figure 1 (a) and (b), modes of exerting forces to nanoparticles and particles to amalgamate can be traced from the bright field transmission microscope (BF-TM) images. Nanoparticles and particles having geometrical shapes amalgamate within the common vicinities in solution under controlled behavior of forcing exertions. When the gap between two nanoparticles or two particles (or between both of them) exceeds the required lengths, they do not amalgamate. If they do so, they take more time. In Figure 1 (a), agglomerations of nanoparticles in three different regions of the same zone is shown. In region (1) of Figure 1 (a), two triangle-shaped particles do not adhere side by side or face to face. In region (2) of Figure 1 (a), a different mechanism is involved to amalgamate distorted nanoparticles. In region (3) of Figure 1 (a), triangle and hexagon-shaped particles adjust side by side filling the space. In

Figure 1 (a), distorted nanoparticles do not conceive the regular focusing of lengths, so their directing sides deal with uneven exertions of forces while amalgamation. Hence, they do not adjust side by side or face to face.

A large-sized particle labelled by (4) halted amalgamation of those nanoparticles and particles occupying regions (2) and (3) in Figure 1 (b). In Figure 1 (b), a nanoparticle labeled by (1) does not conceive the focusing length to amalgamate. So, that nanoparticle will stay undisturbed. The exertions of force for it to amalgamate do not synchronize. It maintains isolation till medium dynamics are not favoring to attain the length of its focus. As in Figures 1 (a) and 1 (b), nanoparticles and particles of different lateral widths overlapped as well, and they developed for different durations.

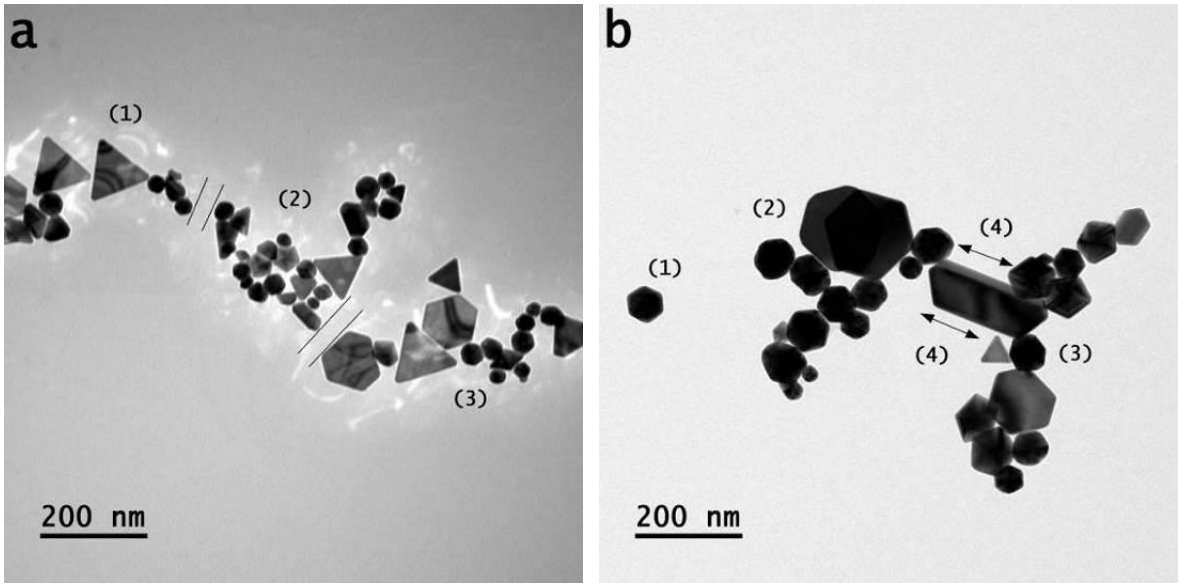
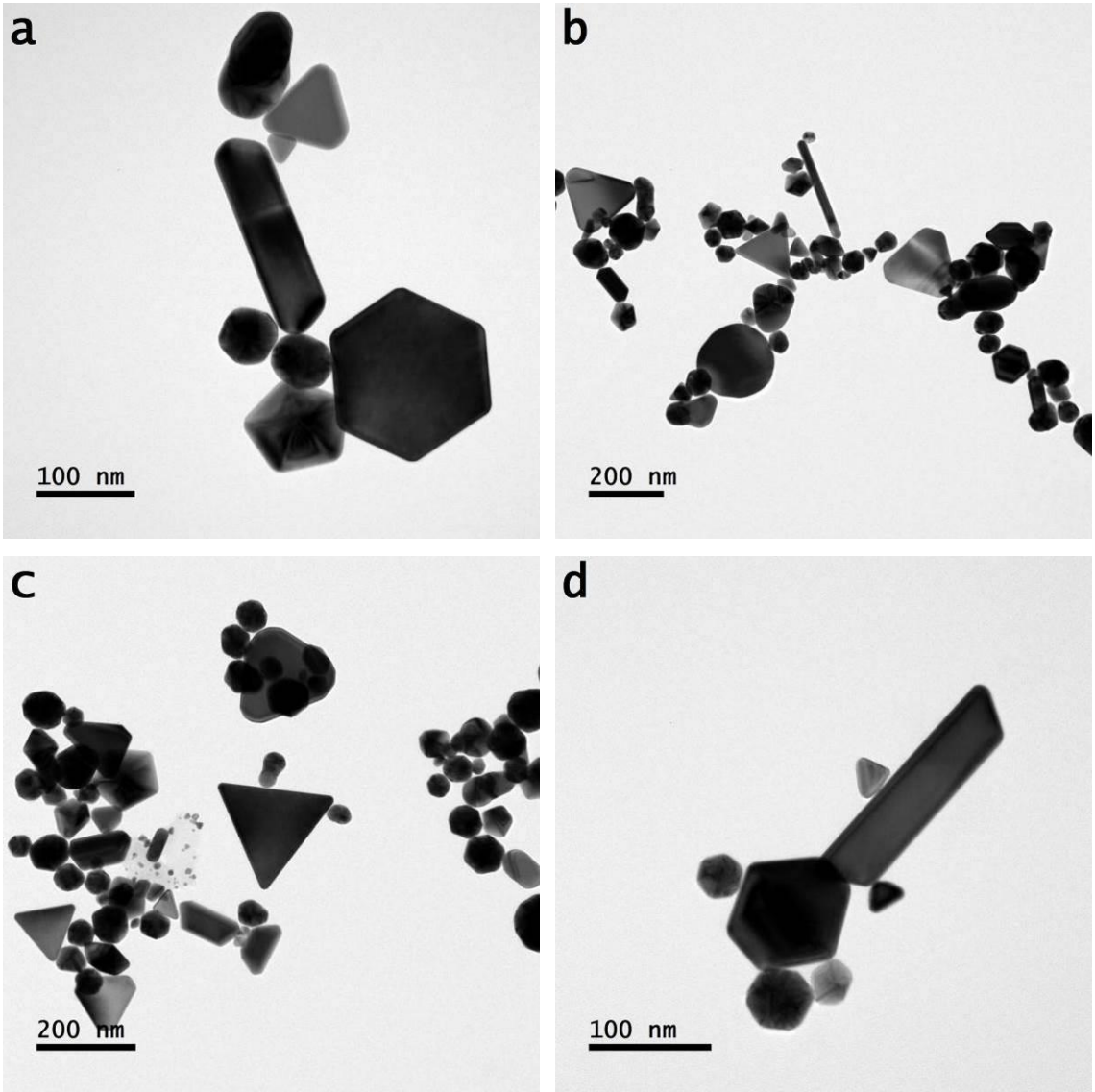
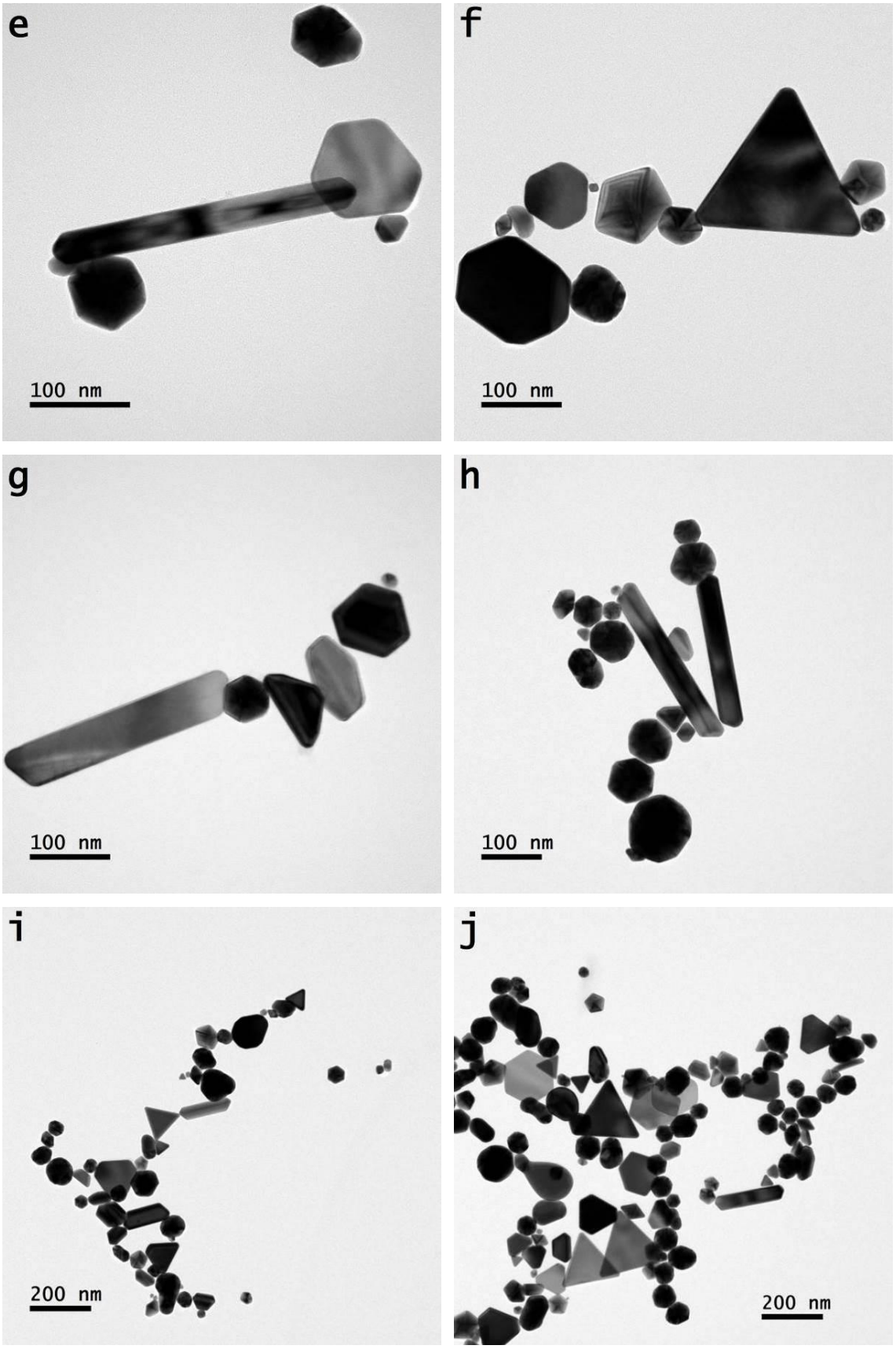


Figure 1: BF-TM images of nanoparticles and particles show modes of amalgamation in both geometrical and distorted shapes developed at (a) precursor concentration 0.10 mM, argon gas flow rate 50 sccm and the process duration is 10 minutes, and (b) precursor concentration 0.30 mM, argon gas flow rate 100 sccm and the process duration is 10 minutes; experimental detail is given in ref. 10

Different BF-TM images of amalgamated nanoparticles and particles are shown in Figure 2 (a-l). In each BF-TM image, nanoparticles and particles amalgamated by tracing a different model of forced exertions, which can be plotted. It comes with a different cluster of information not only in the physical and chemical sciences, but in the different mathematical areas, too. Here, studies related to computational physics and mathematics can be investigated. When comparing the agglomerates shaped by

amalgamated nanoparticles and particles in one BF-TM image to another BF-TM image, they also extract a different model of forcing exertions while amalgamating (or forced exertions while amalgamated). So, they present important science and practical usage of knowledge in different areas. Images of amalgamated nanoparticles and particles presented in Figure 2 (a-l) extract different modes of exerting forces.

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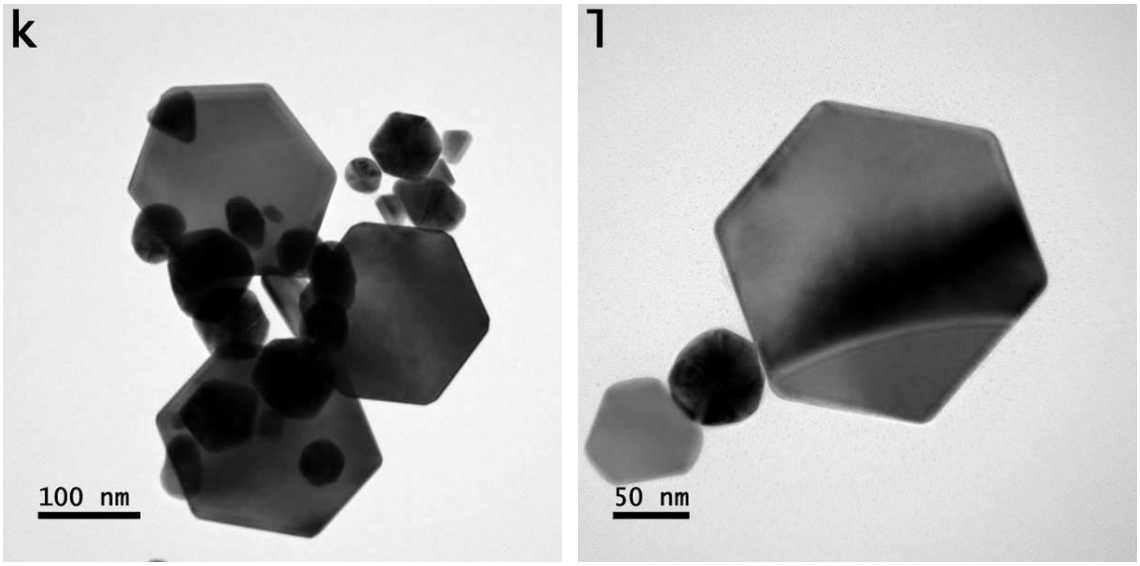
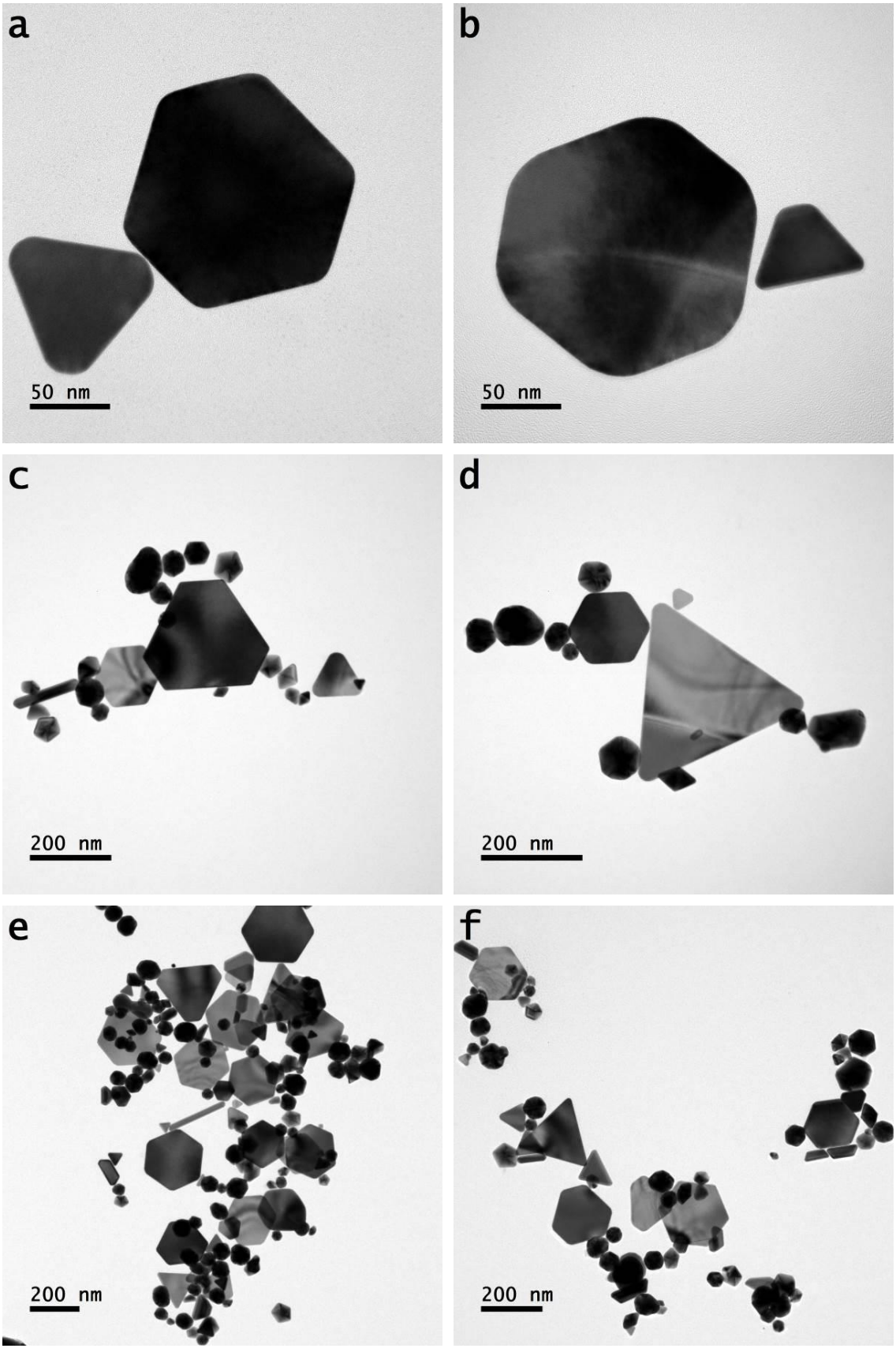


Figure 2: (a-l) BF-TM images of nanoparticles and particles show modes of amalgamation in both geometrical and distorted shapes developed at precursor concentration 0.40 mM, pulse ON/OFF time 5 microseconds, argon gas flow rate 100 sccm and the process duration is 20 minutes; experimental detail is given in ref. 11

Nanoparticles and particles shown in Figure 3 (a-h) developed when pulse ON/OFF time was kept 15 microseconds where other parameters were kept same as in the case of nanoparticles and particles shown in Figure 2 (a-l). Here, nanoparticles and particles also amalgamated by tracing different trajectories of forcing exertions in the formation of their aggregates. However, nanoparticles and particles developed with a bit modified structure of atoms as compared to the nanoparticles and particles developed at pulse ON/OFF time 5 microseconds. In terms of shape and size of those nanoparticles and particles, they appear in the same features. However, they developed under a bit different structure. A bit different structure of nanoparticles and particles shown in BF-TM images of Figure 3 (a-d) also gives rise to their different chemical behaviors. Such studies can be thought in the fields of chemical sciences. To meet the pre-determined requirement of the agglomerates, the development of nanoparticles and particles in selective size and shape can be achieved.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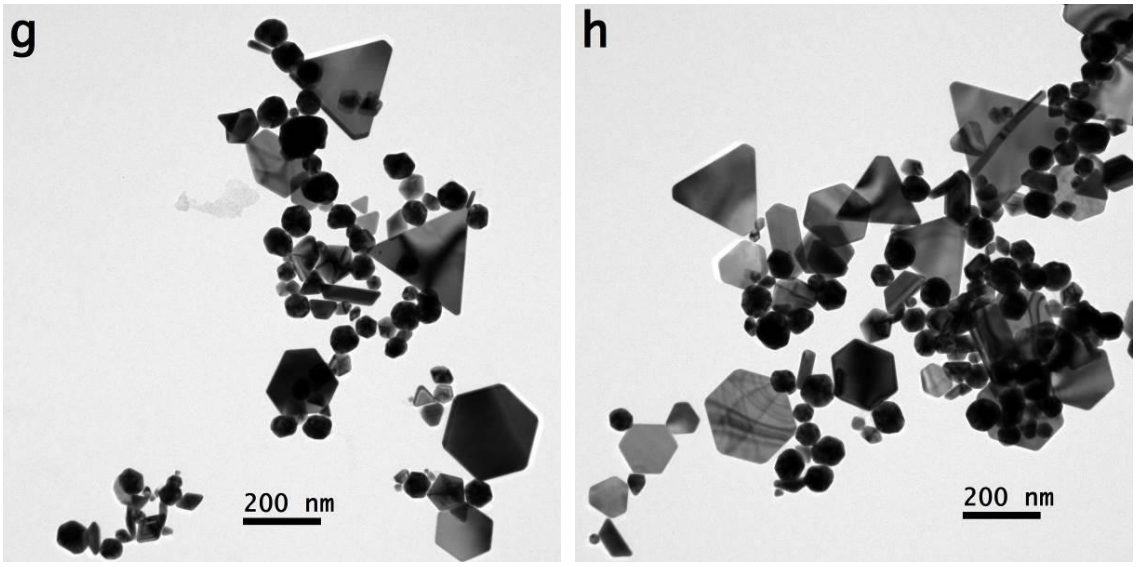

Figure 3: (a-h) BF-TM images of nanoparticles and particles show modes of amalgamation in both geometrical and distorted shapes developed at precursor concentration 0.40 mM, pulse ON/OFF time 15 microseconds, argon gas flow rate 100 sccm and the process duration is 20 minutes; experimental detail is given in ref. 11

In different BF-TM images shown in Figure 3 (e-h), an irregular behavior of exerting forces in amalgamation of different featured nanoparticles and particles can also help to sort out the influence of process parameters. Nanoparticles and particles amalgamated under an altered process of synergy where locally driven parameters might not remain synchronized with the normal pace of exerting forces. Such modes of amalgamating nanoparticles and particles can explore new knowledge in the formation of aggregates, so establishing science of trivial mechanisms.

In Figure 4 (a), a hexagon-shaped particle focuses with respect to a distorted particle under the gap of suitable length. They can attain favorable positions to conceive the focusing of lengths of amalgamation at common vicinity, which is through forcing exertion of the medium dynamics. When both the particles are in distorted shapes, they amalgamate under zigzag interactions as shown in Figure 4 (b). Conceiving focusing of lengths for their amalgamation depends on the variation of forcing exertions. Their interactions with solution occur by plotting the non-linear trajectories. On amalgamation, they can also deform. They scheme different stalls of distribution as given in Figure 4 (c).

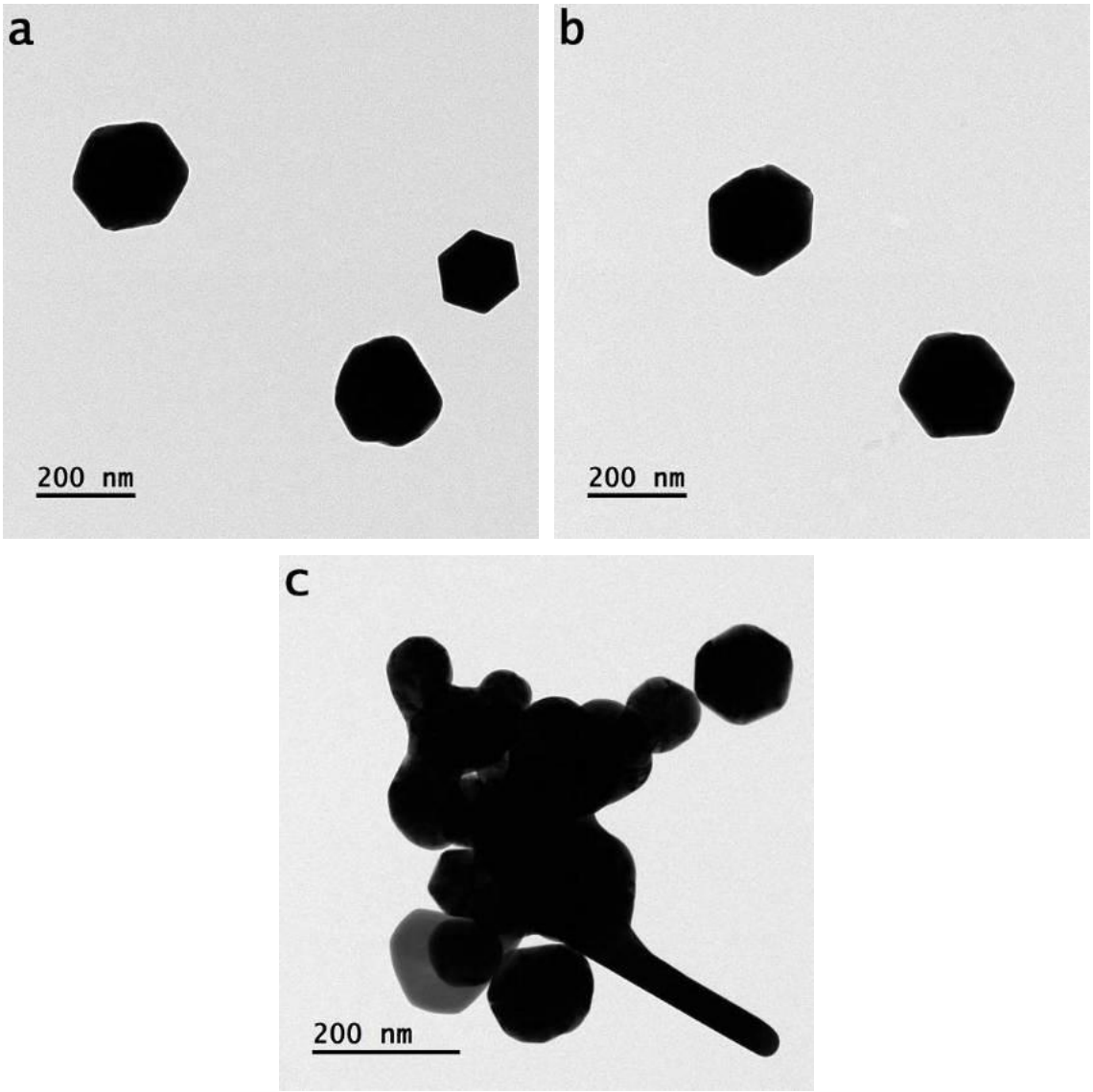

Figure 4: BF-TM images of different particles show modes of amalgamation in both geometrical and distorted shapes developed at (a) and (b) precursor concentration 0.60 mM, argon gas flow rate 100 sccm and the process duration is 10 minutes and (c) precursor concentration 0.60 mM, argon gas flow rate 100 sccm and the process duration is 15 minutes; experimental detail is given in ref. 12

In Figure 5 (a-d), different microscopic images show distribution of nanoparticles and particles in different manners. In different shaped agglomerations shown in the microscopic images of Figure 5 (a-d), nanoparticles and particles adhere tightly. In some cases, nanoparticles and particles adhere loosely. In other cases, nanoparticles and particles also overlap. Amalgamated nanoparticles and particles under forced exertions to scheme different agglomerations are shown in Figure 5 (a-d). Their predicted zones inside the solution are sketched in Figure 6.

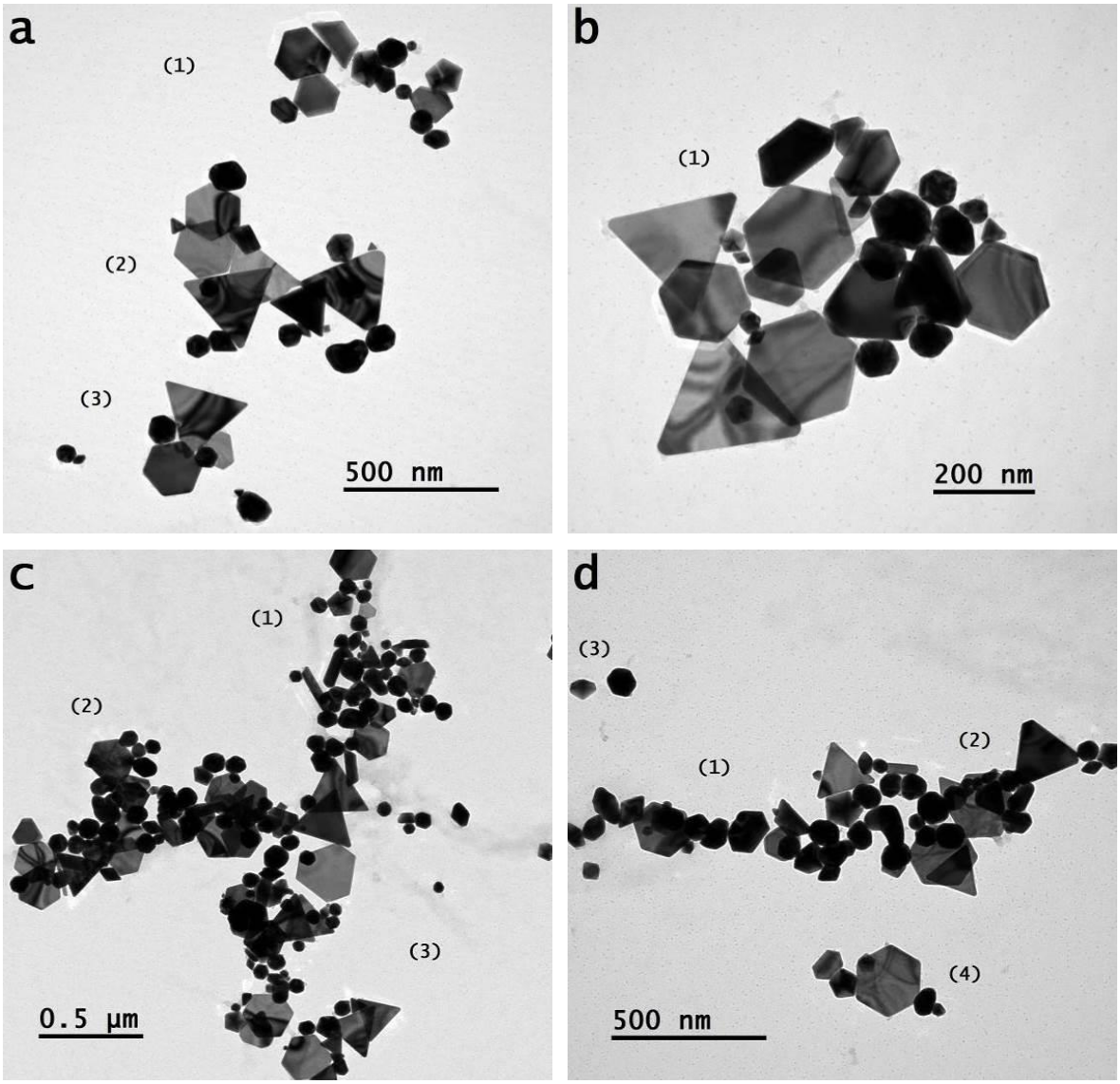

Figure 5: (a-d) BF-TM images of different nanoparticles and particles show modes of amalgamation in both geometrical and distorted shapes developed at precursor concentration 0.30 mM, argon gas flow rate 100 sccm and the process duration is 2 minutes; experimental detail is given in ref. 13

Developed nanoparticles and particles inside the solution are categorized in terms of agglomerating in four quadrants, i.e., Q1, Q2, Q3 and Q4. These are displayed in Figure 6. The centre of four quadrants is related to a point where different nanoparticles and particles developed. Each quadrant can display more than one region of amalgamation of nanoparticles and particles. They conceive the respective focusing of lengths to amalgamate at common vicinity. The focus can be worked out by finding the force exerted along the sides of nanoparticles or particles directed to amalgamate them. Exertions of forces first orientate by tuning the sides directing to

amalgamate their nanoparticles and particles. Nanoparticles and particles shown in Figure 5 (a) depict the centers of joining in three different regions of solution within the same zone (Q1) as labelled in Figure 6. Nanoparticles and particles shown in Figure 5 (b) depict vicinity of amalgamation in one zone only (Q2), which is shown in Figure 6. Nanoparticles and particles shown in Figure 5 (c) depict vicinities of amalgamations in different zones, i.e., Q2, Q3 and Q4 as in Figure 6. Nanoparticles and particles of Figure 5 (d) predict common vicinity of amalgamation in single zone, i.e., Q4 (along x-axis) as given in Figure 6.

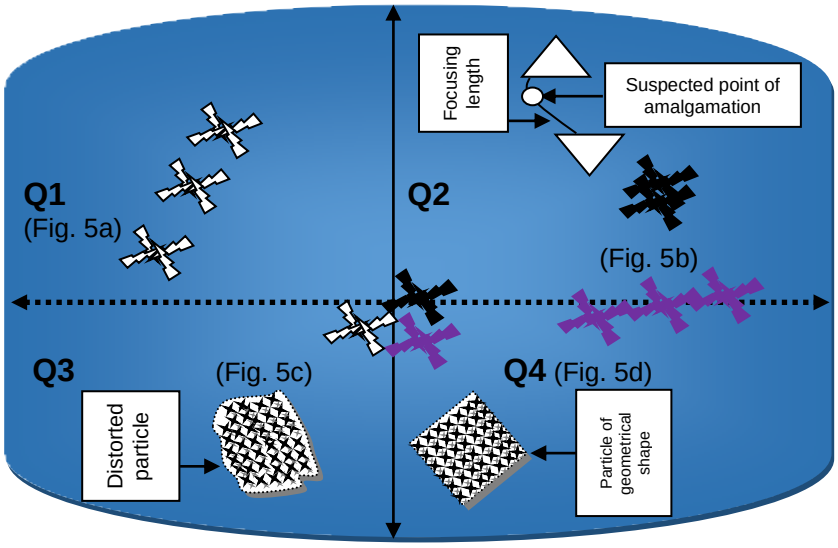

Figure 6: In Q1, Q2, Q3 and Q4, tracing forced exertions of amalgamated nanoparticles and particles are shown in Figure 5 (a-d); suspected point of amalgamation of two identical shaped particles is shown in the vicinity of Q2, a distorted particle having non-orientated electrons adjacent-wise and lateral-wise is shown in the vicinity of Q3 and a particle of geometrical shape having orientated electrons adjacent-wise and lateral-wise is shown in the vicinity of Q4; a sketch is drawn in estimation

Different interactions prevail in the course of amalgamations of colloidal entities. On amalgamation in regions of suitable zones, colloidal entities design the overall shape of their distributions. The overall displayed shape of amalgamated nanoparticles and particles under exertions of forces is called agglomeration. Nanoparticles and particles amalgamate inside the solution by locating their common vicinity. Initially, a nanoparticle or particle remains static with the solution. In static interaction of a nanoparticle or particle with the solution, force remains in mute mode,

while energy behavior remains in functioning mode. In limiting interaction of a nanoparticle or particle with the solution, a force remains in alert (in ready to work, apply, influence or exert) mode, while energy also remains in alert (but in ready to quiet, not work, not apply, not influence or not exert) mode. In kinetic interaction of a nanoparticle or particle with the solution, force remained in functioning (working, applying, influencing or exerting) mode, while energy remained in mute (quiet) mode.

On amalgamation of colloidal entities in suitable vicinity of solution, their forced exertions can be influenced by reflexes of surrounding environment, where their energy functions either to keep them still or to keep them in collective motion.

A kinetic interaction of a nanoparticle or particle having geometrical shape with solution is a controlled interaction. A focusing of length of nanoparticle or particle in geometrical shape with respect to a focusing of length of another identically featured nanoparticle or particle does not infer their amalgamation at midpoint (half-length) of gap noticeable between them. Nonetheless, they locate a suspected point of amalgamation, which is at a certain gap of their conceived focusing of lengths. They will coordinate to amalgamate (at a suspected point) with reference to exerting force along directing sides. Consequently, a suspected point of amalgamation of two nanoparticles or particles is located through the resultant differences of poles' forces in occupied quadrant and in their resting positions as estimated in Q2 of Figure 6.

Each particle of geometrical shape conceives its own length of focusing but with reference to the attending one(s) at common vicinity. This is due to the coordination of other particle(s) of geometrical shape(s). So, nanoparticles and particles of geometrical shapes amalgamate at common vicinities under the resultant differences of forces exerting in their occupied quadrants and in their points of resting positions. Experiencing the differences of forces of their own drawn poles, they altogether also deal with the differences of forces related to occupied quadrants. Their amalgamation is under two drawn origins: internal origin depicted by their own poles drawn when at resting position, and external origin depicted by the occupied region in quadrant. This way, they consider the resultant differences of forces belonging to two frame of references in their amalgamation. So, the focusing lengths of amalgamating nanoparticles and particles are directly proportional to the resultant differences of exerting forces obtained along their directing sides. The introduction of a suitable

constant equalizes the proportionality between two variables. A force of the quadrant as per traced poles is already there to exert. A nanoparticle or particle occupies a certain region of the quadrant. It also traces its own poles to deal with the forcing exertions. So, in the case of considering plain region of nanoparticles or particles having identical geometrical shapes, they amalgamate side by side inside the solution by coordinating with the forces of two frame of references mainly. There can be the influence of third frame of reference or even more frames of references when nanoparticles or particles are not in geometrical shapes under matched lateral width.

To calculate the resultant difference of an exerting force to nanoparticle or particle of geometrical shape from two frame of references, a transformational law under the rotation of basis vectors can be helpful. There can be more parameters (factors) involved when studying the forcing or forced exertions in amalgamations of nanoparticles and particles. These can be related to features of nanoparticles and particles along with their occupied vicinities inside the solution. Different lateral widths of nanoparticles or particles with the same shape can also alter the modes of their amalgamation. Both surface topography and aspect ratio of nanoparticles and particles contribute in the study of modes of their amalgamations. In order to establish the concrete equations on amalgamations of different featured nanoparticles and particles inside the solution, much work is required. In the case of distorted nanoparticles or particles, a kinetic interaction with solution is a largely uncontrolled interaction. When nanoparticles or particles possess distorted shapes, their static interaction, limiting interaction and kinetic interaction with the solution occur more in an irregular way, where they can further deform their shapes.

Normally, different frictional behaviors are being considered in the case of solid surfaces when in contact. However, in a colloidal solution, a partial behavior of the force exists, which leads to introduce a partial behavior of friction in the form of interaction. So, nanoparticles and particles deal with their partial interactions with the solution. Entered forces deal with even exertion throughout the solution to keep liquidness.

In distorted nanoparticles and particles, electrons of deformed or distorted atoms orientated non-adjacent-wise and non-lateral-wise. The misaligned positions of electrons keep irregular ordering of atoms in the development of nanoparticles and

particles. Electrons of atoms neither get aligned under the standard format of exerting forces nor get aligned under surface format of exerting forces. This is how the electrons interplay in atoms developing tiny particle and particle having no regular shape. Such nanoparticle or particle does not draw a straight trajectory of appreciable length when conceiving its length of focusing.

It was found in the selective area patterns that the electrons belonging to central rings along with outer rings of elongated atoms in hexagon and triangle-shaped particles remained in lateral orientations, but electrons belonging to only central rings of atoms in rod and bar-shaped particles remained in lateral orientations [7]; hexagon and triangle-shaped particles are related to multi-dimensional (MD) particles, whereas rod and bar-shaped particles are related to one-dimensional (1D) particles.

Presence of even single deformed atom in the development of a nanoparticle or particle means a distorted nanoparticle or particle as shown in Q3 of Figure 6. Electrons aligned non-orientationally in the atoms of distorted nanoparticles and particles. Their electrons neither orientate laterally nor adjacently. Thus, conceived focusing lengths of such nanoparticles and particles result in the asymmetric behaviors of amalgamations (Q3 in Figure 6). In nanoparticles and particles having geometrical shapes, atoms keep their electrons laterally and adjacently orientated along each side. So, they amalgamate under controlled angle interactions (Q4 in Figure 6).

In each side of nanoparticle or particle having geometrical shape, electrons (of elongated atoms of arrays which formed structures of smooth elements) aligned orientationally. In all structures of smooth elements forming each mono layer (not monolayer) of nanoparticle or particle, electrons of elongated atoms (forming each face) aligned at each side as shown in Q4 of Figure 6. The configurations of electrons of elongated atoms in each face of 1D or MD nanoparticle or particle are remained orientated. Hence, the gained orientational positions of electrons in each face of such nanoparticles or particles deal with a structure of consistent inter-state gap. According to the suitable design of a material, a structure of consistent inter-state electron gap can be made to work in 1D, 2D or 3D. Such kinds of nanoparticles and particles deal with an accelerated propagation of photons, which is not the case

with distorted nanoparticles and particles. However, distorted nanoparticles and particles can work as catalytic agents to dissipate the heat locally.

Both solution composition and medium source influence the forcing or forced exertions in amalgamation of nanoparticles and particles. Thus, trajectories of suspected points of amalgamations on conceived lengths of focusing in different featured nanoparticles and particles can be plotted for several ways. These require in-depth studies to explore the underlying sciences. Here, different features of nanoparticles and particles need to be considered. These studies may explore interesting new insights for the scientific community. Modes of forcing or forced exertions to nanoparticles and particles of different features are needed to be explored. A behavior of force to distorted particle and particle of geometrical shape is identified in different ways. Here both computational physics and mathematics can be helpful to trace the exerting forces. These open new areas for researching and applying new knowledge at multiple scales.

In mathematics, new knowledge in the fields of vector analysis, vector space, topology, mechanics, calculus and analytical geometry, etc. can be established. As the shape of nanoparticles and particles becomes more and more distorted, the influence of forces in different formats also becomes more and more chaotic. This is because neither the precise length nor the precise diameter of these particles can be measured. To measure their approximate size, it is required to locate their centre of mass first. This way, the studies of colloids provide a vast room for conducting new research.

In amalgamation of nanoparticles and particles, the relation of exerting forces to focusing lengths and energy behavior at different levels can open countless avenues for scientific research. Such fields of studies can also engage students, researchers and scientists to conduct different statistical analyses. Fundamental questions on the stability of colloidal nanoparticles and roles of different surfactants and ligands for them are yet to be explored [34]. A study of orientation provides a new avenue to study the structure of nano-components of different materials [35].

3. Conclusion

Nanoparticles and particles which do not possess geometrical shapes, they amalgamate inside the solution by drawing asymmetrical trajectories. Here, deformed or distorted atoms experience uneven exertions of force for electrons. Resulted focusing lengths of distorted nanoparticles and particles trace non-linear trajectories. They also approach, adhere, overlap and amalgamate while encountering static, limiting and kinetic interactions. To counteract conceived focusing lengths, distorted nanoparticles and particles can distort further by changing kinetic modes.

On developing, nanoparticles and particles amalgamate inside the solution for different zones depending on the modes of their processing. Amalgamating nanoparticles and particles having no specific shapes also deal with static, limiting and kinetic interactions to scheme stalls. Agglomerates resulted by the amalgamations of nanoparticles and particles depend on the conditions of their processing.

A patterned stall requires geometric consistency in amalgamated nanoparticles and particles. Nanoparticles and particles, which possess geometrical shapes, they amalgamate under controlled exertions of force as electrons of elongated atoms get orientated along their directing sides; geometric shapes experience forces of two well-recognized frame of references. On amalgamation, such two nanoparticles or particles can join side by side or face to face at midpoint of noticeable gap (length) between them. In amalgamation of a nanoparticle or particle having geometrical shape, a conceived focusing length becomes functioning from the side having controlled exertion of (even) force to a greater extent. To amalgamate, focusing lengths of such nanoparticles or particles plot trajectories of directional behaviors. They undertake standard interactions in amalgamation, where forcing or forced exertions to electrons of elongated atoms work in a diligent manner by successively remaining mute (in static behavior), alert (in limiting behavior) and functioning (in kinetic behavior). A forcing or forced exertion to nanoparticle or particle originates energy behavior accordingly.

To amalgamate nanoparticles or particles at common vicinity, in addition to resultant difference of exerting forces of poles in occupied quadrants of medium, they also deal with the resultant difference of forces of their own poles drawn when at resting positions. A conceived focusing length of a nanoparticle or particle functions

under the overall difference of forces (of medium poles and own drawn poles). So, a force resulted along the directing side of a particle is due to the resultant differences of forces of medium poles and own drawn poles. Hence, resulted force leads to its amalgamation at a located suspected point.

Nanoparticles and particles of perfect geometrical shapes having the same lateral lengths amalgamate side by side, where they deal with quantized exertions of force, so they also deal with energy behavior in quantized manner. They amalgamate for required directions searched through conceived focusing of lengths, so they show symmetry in amalgamation. This is also the case in microscopic images of colloidal nanoparticles and particles. Nanoparticles and particles foresee the exertions of forces in their amalgamations to scheme agglomerates. So, they present the significance of environment related to processing solution.

In nanoparticles and particles of geometrical shapes, electrons of atoms deal with aligned position along each side of the shape. Electrons experience the even forcing exertions along the poles, where they remain clamped in their energy knots. So, energy knots forming filled and unfilled states of electrons do not response to forcing or forced exertions. However, energy knots are influenced by the varied (orientation) force and (potential) energy of their electrons [35]. Distorted particles show distorted behavior where electrons of deformed atoms do not align orientationally.

Nanoparticles and particles of selective features amalgamate under controlled applications of forced exertions. They can be used effectively as medication in various illnesses. The studies of forcing or forced exertions to nanoparticles and particles inside the solution help to develop sustainable science and technology covering applications of broad range in catalysis, optics, biomedical, energy and diversified eco-friendly environments. Hence, they open several new routes for research and exploration.

4. Experimental details

Different BF-TM images discussed in Figures 1, 2, 3, 4 & 5 are synthesized by setting different process parameters, where the main parameters are given in the captions of the figures. Layouts of the setup along with different conditions are given in earlier references [10-13]. The method employed to synthesize nanoparticles and particles

discussed in this work can be referred to as photochemical method, or conventionally as an electrochemical method in chemical sciences. It is also called pulse-based electron-photon/solution interface process in the studies given in references 10 to 13.

Acknowledgements

Mubarak Ali sincerely thanks the National Science Council (now Ministry of Science and Technology) Taiwan (R.O.C.) for awarding postdoctorship: NSC-102-2811-M-032-008 (August 2013- July 2014). Authors thank Mr. Chien-Jui Yeh for helping in transmission microscope operation.

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Nomenclatures/definitions:

Dynamics – *Changing aspects of different entities (atoms, tiny particles, tiny clusters, nano crystal, molecule like structures, nanoparticles and particles, etc.)*

Grammatical use of dynamics – *Dynamics should be used as a 'noun' but mainly in 'plural' sense. Usually, an entity considers more than one factor simultaneously occurring to change its aspect. So, dynamics are related to changing aspects of an entity. However, it is also used in 'singular' sense, where the employed 'verb' in the sentence identify the meaning*

Visualized dynamics – *Observation of changing aspects of different entities while recording their live behavior inside the solution*

Internal Medium dynamics – *Changing behavior (aspect) of the medium (solution) through the development of different entities, interactions of entities with each other and interaction of different entities with the walls of beaker or container along with impact of different input parameters govern the medium dynamics, internally*

External Medium dynamics – *Entering forced energy electrons, electron streams and atoms, entering photons of different features and absorption of heat energy in the solution relate to external medium dynamics.*

The process of synergy – *Medium dynamics, both internal and external, govern the process of synergy*

Amalgamation – *This is a process taken or followed by nanoparticles and particles to join, overlap or adhere inside the solution through competing actions of forces along their sides. However,*

tiny particles also amalgamate to develop a nanoparticle or particle at solution surface or inside the solution

Agglomeration – *A zone inside the solution, where nanoparticles and particles amalgamated through a suitable mechanism of forced exertion exhibiting overall picture of their aggregated stall*

Forcing exertion – *A force disturbs to amalgamate a nanoparticle or particle inside the solution*

Forced exertion – *A force disturbed to amalgamate a nanoparticle or particle inside the solution*

Focusing length – *A focusing length of nanoparticle or particle inside the solution is conceived by locating a suspected point of its amalgamation under a noticeable length (gap), where one nanoparticle or particle experiences force with respect to the force of nearby nanoparticle or particle. So, through the action of force, they (nanoparticles or particles or both) attempt to disturb by directing their amalgamation at common vicinity inside the solution. Focusing length is not useful while considering tiny particles or atoms as they do not remain still for significant times inside the solution*

Suspected point – *It is a point located by two entities (nanoparticles or particles) prior to amalgamating at common vicinity inside the solution, which is through conceiving of lengths of focusing of two or more nanoparticles or particles. In the case of two identical shaped (and sized) nanoparticles or particles, their suspected point can be located at midpoint of noticeable gap (length) between them; a suspected point of amalgamation of two nanoparticles or particles is located under the resultant differences of forces of their own poles drawn and poles drawn in occupied quadrant of medium at resting positions in that quadrant*

Zones of solution surface – *A solution surface in a beaker has four zones as it made four quadrants from the point of development of nanoparticles and particles*

Regions of solution surface – *A zone of solution surface can have one region or more than one region inside the solution to amalgamate nanoparticles or particles*

Distorted nanoparticles and particles – *Nanoparticles and particles having their irregular shapes, where no certain geometry of the shape is perceptible*

Geometric shapes – *Shapes of nanoparticles and particles having their directional behavior, which mainly develop in one-dimensional shapes or multi-dimensional shapes*

Adjacent orientation of electrons – *In nanoparticles or particles of geometrical shapes, electrons of outer rings (belonging to elongated atoms) deal with their aligned positions as they are in adjacent orientations under the even exertions of force*

Lateral orientations of electrons – *In nanoparticles or particles of geometrical shapes, electrons of inner or central rings (belonging to elongated atoms) deal with their aligned positions as they are in lateral orientations under the even exertions of force*

Distorted adjacent orientations of electrons – *In deformed or partially elongated atoms of distorted nanoparticles or particles of irregular shapes, electrons of outer rings do not align to orientate fully adjacent-wise under uneven exertions of force*

Distorted lateral orientations of electrons – *In deformed or partially elongated atoms of distorted nanoparticles or particles of irregular shapes, electrons of inner or central rings do not align to orientate fully lateral-wise under uneven exertions of force*

Orientated electrons – *Electrons orientated either adjacently or laterally under the even exertion of forces along the poles*

Non-orientated electrons – *Electrons which did not orientate either adjacently or laterally under the uneven exertion of forces along the poles*

Even exertion of force – *In an elongated atom, electrons clamped by their energy knots undertook even exertion of force to orientate adjacent-wise*

Uneven exertion of force – *In deformed or distorted atom, electrons clamped by their energy knots undertook uneven exertion of force to orientate non-adjacent-wise*

Authors' biography:

Mubarak Ali graduated from University of the Punjab with BSc (Phys & Maths) in 1996 and MSc Materials Science with distinction from Bahauddin Zakariya University, Multan, Pakistan (1998); his thesis work completed at Quaid-i-Azam University Islamabad. He gained PhD in Mechanical Engineering from the Universiti Teknologi Malaysia under the award of Malaysian Technical Cooperation Programme (MTCP;2004-07) and postdoc in advanced surface technologies at Istanbul Technical University under the foreign fellowship of The Scientific and Technological Research Council of Turkey (TÜBİTAK, 2010). He completed another postdoc in the field of

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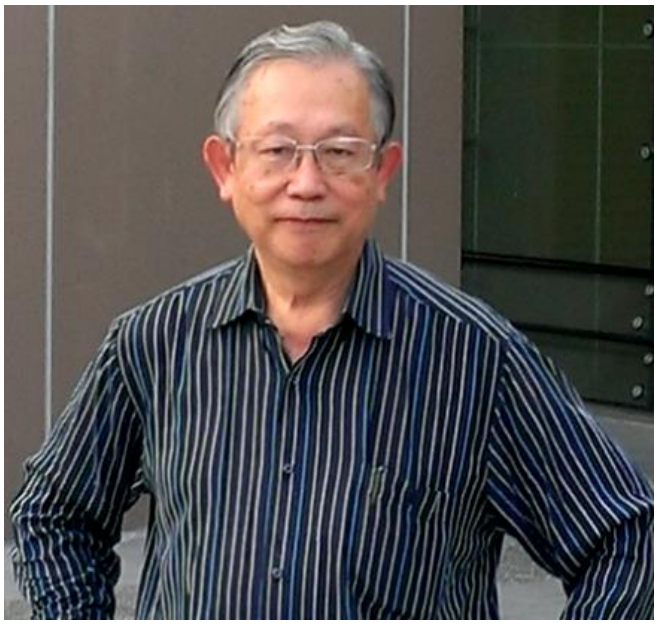

His Excellency, **I-Nan Lin**, worked as a **Senior Professor** for several years at Tamkang University, Taiwan, and now **Professor Emeritus**. His Excellency received the bachelor's degree in physics from National Taiwan Normal University, Taiwan, M.S. from National Tsing-Hua University, Taiwan, and the Ph.D. degree in Materials Science from U. C. Berkeley in 1979, U.S.A. His Excellency, worked as a senior researcher in Materials Science Centre in Tsing-Hua University for several years and a faculty member as senior professor in Department of Physics, Tamkang University. Professor Lin published several hundred referred journal publications and held distinctive position in university. Professor I-Nan Lin supervised several PhD and Postdoc candidates around the world. Professor I-Nan Lin remained researching in the areas of developing high conductivity diamond films, composite materials and the deep-rooted studies of the transmission microscopy of materials.