Review Article

Nanoparticles of Gecko and Its Approach in Advance Biomedical Remedies- An Overview

Atanu Bhattacharyya¹, Reddy Shetty Prakasham², Raja NaikaH³, S Janardana Reddy⁴, M M Adeyemi⁵ and Omkar⁶

¹ Nanotechnology Section, Department of Biomedical Engineering, Rajiv Gandhi Institute of Technology, RT Nagar, Hebbal, Bangalore – 560 032, India
² Bioengineering and Environmental Centre, Indian Institute of Chemical Technology, Hyderabad - 500 007, India.
³ Department of Studies and Research in Environmental Science, Bharathia Ratna Prof. C.N.R. Rao Block, Lab. No104, First Floor, Tumkur University, Tumkur- 572103, Karnataka, India
⁴ Department of Fishery Science and Aquaculture, Sri Venkateswara University, Tirupathi-517 502, India.
⁵ Nigerian Defence Academy, Department of Chemistry, P.M.B. 2109, Kaduna, Kaduna State, Nigeria.
⁶ Ladybird Research Laboratory, Department of Zoology, University of Lucknow, Lucknow-226007, India.

*Corresponding author
Atanu Bhattacharyya
Nanotechnology Section, Department of Biomedical Engineering, Rajiv Gandhi Institute of Technology, RT Nagar, Hebbal, Bangalore – 560 032, India
E-mail: atanubhatt@rediffmail.com

Published: 22-10-2015
Biojournal of Science and Technology Vol.2: 2015
Academic Editor: Editor-in-Chief
Received: 18-08-2015
Accepted: 30-09-2015
Article no: m150002

Published: 22-10-2015
Biojournal of Science and Technology Vol.2: 2015
Academic Editor: Editor-in-Chief
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Academic Editor: Editor-in-Chief

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Abstract

The setal hair of Gecko (Gekko gecko, Linnaeus, 1758) pad plays an important role in sticking together on surface. This machinery performs through a force considered as Vander wall force. The adhesive mechanism of Gecko pads in maintains the hydrophilic-lyophilise balance (HLB) where the surface proteins may take part in a predominant way. With the help of surface force apparatus (SFA), it was obvious that the adhesion and abrasion services of Gecko, shear the setal arrangement adjacent to a silica plane under appropriate dry situation by means of 100% humidity. Moreover, it can consider here when the setal arrangement are completely immersed in water, the stick condition of setal arrangement increases on the surface. Even though the grip services transformed considerably, the rasping services remain unchanged, signifying that the chafing stuck between highly textured surfaces is 'load-controlled' rather than 'adhesion-controlled'. Gecko’s use millions of adhesive setae on their toes to climb vertical surfaces at speeds of over 1ms⁻¹. Climbing of Gecko posses a significant challenge for an adhesive strong attachment and easy removal of the feet from the surface. Conventional pressure sensitive adhesions (PSAs) are pliable viscoelastic polymers that debase, unclean, self-adhere and fasten by chance to inappropriately on facade. Gecko toes bear angled array of pronged, hair-like setae created commencing exact, hydrophobic keratin with the purpose for achievement as a bed at an angle spring with interrelated efficient expandable modulus to that of conventional pressure sensitive adhesions (PSAs). Several bio molecules of the feet of the Gecko’s are the most helpful things or noteworthy in
several natural processes. Gecko-like synthetic adhesives may become the glue of the future and perhaps the bubble of the future as well.

**Keywords:** Steal hair, Gecko, Pressure Sensitive Adhesive, Friction forces, Vander Wall Force, Hydrophilic-lyophilic balance (HLB), Load-controlled, Conventional pressure sensitive adhesives (PSAs), Keratin of Gecko pads
INTRODUCTION
Gecko- *Gekko gecko* (Linnaeus, 1758) has the ability of adhesion property on the thumb pad nanomaterials which have evolved with the development of several sequences of new genes and genomes (Nanowerk news, 2015). These have opened a treasure trove of information about living systems of Gecko which can open new area of investigation. The process and commodities of development, cell splitting up and regulation, protein fabrication, hormone manufacture guideline and homeostasis are all the result of organism evolution (Schwenk, et al., 2009). As Darwin recognized, individual organisms and their natural selection deals with the integrated phenotype and operates to produce the adaptations and diversification in the physiology of Gecko-*Gekko gecko* (Linnaeus, 1758) and thus with this adhesive pads this individual exits in the nature still today (Nanowerk news, 2015). Gecko- *Gekko gecko* (Linnaeus, 1758) are lizards belonging to the infra-order Gekkota, found in humid climates all through the world. Their body size assortment varies from 1.6 to 60 cm. Most geckos cannot open and close the eye, but they often overcome their eyes to maintain them dirt-free and humid. They have been everlasting lens surrounded by each iris that enlarge in darkness to allow more light. Geckos are exceptional among lizards in their communication (Autumn, et al., 2002). They use chirping sounds in social interactions with other geckos. They are generally dominant group of lizards, with about 1,500 different species worldwide and its taxonomic background is -

**Phylum:** Chordata  
**Class:** Reptilia  
**Order:** Squamata  
**Family:** Gekkonidae

The new Latin ‘gekko’ and English ‘gecko’ from the Indonesian considered as *Malay Gēkoq*. The recent forms of Gecko toes are the important factor, as the toes nanomaterials are great source of medical importance in future (Sitti and Fearing *et al.*, 2002). Gecko toes have special adaptations that allow them to adhere to most surfaces without the use of liquids or surface apprehension. About 60% of Gecko species have adhesive toe pads; such pads have been evolved over the course of Gecko evolution. Gecko footpads enable attractive *vander walls’* forces between the β-keratin lamellae, setae and spatula like structures of Gecko setal pads (Autumn *et al.*, 2002; Jagota and Bennison *et al.*, 2002).

Naturally, it is interesting to propose that Geckos adhere to just about any facade, wet or dry, smooth or rough, hard or soft. The feet of Gecko adhesive are inimitable in that, it is self-cleaning during repeated use. Its adhesion can be mechanically switched on and off in relation to its activity. The sliding mechanism is observed against a surface where uncurls the seta to engage the adhesive process of legs of Gecko (Gorb and Scherge *et al.*, 2000). Moreover, when relaxing the sliding tension, the adhesive can be released from the adjacent areas. These features of Gecko, i.e., enthused artificial adhesives can be made in a non-toxic, biocompatible or biodegradable way (Arzt *et al.*, 2003; Ng *et al.*, 2014).

Now I would like to introduce some facts that when any person touches a Gecko it feels soft and smooth and not sticky at all. If you pressed a Gecko toe onto a hard surface it would not be stick (Bovero and Menon 2014). The toe will only adhere when the microfibers (setae) are occupied in tardy or descending the toe parallel to the surface. If toes were adhesive like tape (Figure 1) it would be difficult for a Gecko to saunter or run, as it would be too firm to drag its foot up. Gecko setae and end plates at the end of stalk (spatulae) which are made chiefly with beta keratin. At the nanoscopic scale, a fiber can make an intimate contact in a very small area. It has been observed that when the feet of Gecko hold fast with some facade on that time the intermolecular armed forces make available an epoxy resin force in the variety from 1 to 1000 nano-Newton (Gao *et al.*, 2003).
Moreover, soft polymers can adhere well to many surfaces, they have several drawback compared to Gecko-tape produced from resources which are so firm as the keratin protein in natural Gecko fibbers (Glassmaker et al., 2000; Bovero and Menon, 2014; Ng, et al., 2014; Seo, et al., 2014). It is interesting to make a note of that while Gecko steal arrays are made of a hard material (primarily beta-keratin) array of long, angled fibres’ of keratin have an equivalent rigidity similar to rubber (Glassmaker et al., 2004; Seo, et al., 2014). It can say here that the soft sticky polymers easily mount up dirt in the surroundings while that are difficult to clean from Geckos self-clean dirt system through their hard hairs. It is interesting to think a piece of adhesive tape as shown in (Figure 1), how picks up dirt and loses its adhesiveness without any difficulty (Peressadko and Gorb, et al., 2004). To reduce clumping, fibre spacing has increased, which reduces density and thus reduce clumping process. Geckos need to be able quickly attach and take away their feet from a exterior. A small gecko can run up a perpendicularly on wall at greater than 1 meter per second. Moreover, attach and flaking its feet more than 20 times per second (Figure 2). It has been observed that when contacting a smooth clean surface such as glass or on smooth leaves (Figure 3), the gecko microfiber array will have less make contact with area than a conventional adhesive tape. Since adhesion is relative to contact area, a conformist adhesive tape will have greater shear (sliding) strength than microfiber array strength. Even a smooth soft piece of rubber will hold fast very well in shear to smooth glass (Wang, et al., 2014). It is attractive to propose that a synthetic soft material sticks better than gecko to a smooth surface such as glass. Gecko can adhere to a rough and dirty surface as we are usually observed in nature. (Figure 4). As we know Geckos have evolved one of the most versatile and effective adhesives process. It cannot over rule the process of Vander walls mechanism which totally related with glue property of Gecko setae (Crosby, et al., 2005). Now it has been evolve the device of dry adhesion in the millions of
setae on the toes of Geckos which has been developed through the suitable scientific study (Autumn, et al., 2014). It is obvious now that Gecko setal process are equally effectual on the hydrophobic and hydrophilic surfaces of a micro electro-mechanical force sensor (Autumn, et al., 2014). It cannot overrule the processes of Vander waals mechanism which totally related with adhesive properties of Gecko setae (Autumn, et al., 2002).

**Figure 3.** Most unique feature of the leg attachment pads of Gecko on smooth surface adopted from Anthony P. Russell and Timothy E. Higham (2009). A new angle on clinging in geckos: incline, not substrate, triggers the deployment of the adhesive system. Proc. R. Soc. B, 276:3705–3709.

**Figure 4.** Showing Gecko walking on rough surface plants. Adopted from Anthony P. Russell and Timothy E. Higham (2009). A new angle on clinging in geckos: incline, not substrate, triggers

The most unique feature of the leg accessory pads posses quite a lot of individuals including many insects, spiders, and lizards, are competent of attaching to a variety of surface and are used for locomotion. Geckos in particular, have the major mass and have developed the most multifaceted hairy attachment structures capable of elegant adhesion power (Bhushan, 2008; Khaled and Sameoto, 2013). These animals construct use of about three million micro scale hairs or setae (about 14000/mm²) that branch off into hundreds of nanoscale spatula (about a billion spatulae). This hierarchical facade edifice gives the Gecko to adaptableness or to produce a huge authentic region to get in touch with surface. A Gecko is capable of produce on the order of 20 N of adhesive strength (Kim, et al., 2013). Gecko retain the capability to get rid of its feet from an attachment surface at its will. The glue potency of Gecko setae is dependent relative on the direction and maximum adhesion occurs at 30º (Krahn and Menon, 2013). During walking a gecko is able to unwrap its foot from surface by altering the angle at which its setae get in touch with a surface (Krahn and Menon, 2013). Geckos found in places with warm climates, have attentive for hundreds of years. Scientists have been especially intrigue by these lizards, and have studied a variety of kind—such as the glue toe pads on the bottom of Gecko feet with which Geckos attach to surface with extraordinary power (Figure 5a & 5b) (Gillies and Fearing, 2014). Several experiments by several scientist clearly denotes that dead Geckos can adhere with the exact same strength as living Gecko’s strength can apply in the field of robotics.

**Adhesive System of Gecko**

Gecko and its adhesive system may think as an instance of biological encouragement in nature. The applications of climbing robots, as well as balance on air vehicle and also in human rock climbing system where synthetic adhesives of
The setae are curved inward, toward the center of the foot. When the gecko pulls back a toe, the setae get straightened. (Image: from Emily Kane)

It has been reasonable that the contact condition of Gecko is very sensitive, but if we like to compare with robust adhesion where individual seta is canted and highly flexible. In resemblance to the ‘cone of friction’, it can believe that the “area of adhesion” - the area of normal and peripheral forces that uphold adhesion. Moreover, it can propose, the sticking together region is highly asymmetric enabling the Gecko to hold fast under a variety of loading circumstances associated with scuttle horizontally, vertically and inverted process. Geckos can go up on a variety of surfaces, as well as on even glass and also other surface (He, et al., 2014). Their gluey toes have inspired climbing devices such as Spider-Man gloves (Congcong and Alex, 2014). The setae stick on to contact surfaces through frictional force process as well as armed forces between every molecule which may consider as Vander waals forces (Taoa, et.al. 2015). These tiny structures are so strong that the setae on a single foot can support twenty times of the Gecko's body weight (Jeong, et al., 2014). Several investigation on Gecko exhibits that dead animals (Gecko) sustain and posses the same aptitude to stick on with the same force as living animals performs (Taoa, et. al., 2015). The reports on Gecko clearly denotes the performance of living Gecko produce forces through their muscle mobilization or through neural bustle, which are solely required for carry out the normal function of Gecko feet (Taoa, et.al. 2015). The consideration of sticking process can be completely motionless which could be pertinent to a lot of diverse kinds of adhesion process in Gecko (Taoa, et.al. 2015; Congcong and Alex, 2014). One existing work suggest that the "active" constituent of Gecko adhesion is in fact a decrease of bond force when the Gecko "hyperextend" its digits - that is, lift them off from the ground by curl up of their tips of the digits while the rest of the foot leftovers on the surface (Taoa, et.al., 2015;
Congcong and Alex, 2014). It has been establish that the dead animals were more likely to familiar of their adhesive system which suggests that the active control may actually prevent injury. In other verbal skill, when the forces become too high, the Gecko likely to release their arrangement through its muscles function (Taoa, et.al. 2015).

The Gecko bonding system has paying attention since the discovery of the van der waals interactions which are always present between surfaces, that are principally accountable for their adhesion (Cremaldi, et al., 2014). The exceptional anisotropic frictional-adhesive ability of the Gecko adhesive system originate from complex hierarchical structures and just as Gecko adhesive can be made-up soft adhesion (F_{\perp} \approx 1.25 \text{ N/cm}^2) and friction (F_{\parallel} \approx 2.8 \text{ N/cm}^2) forces when actuate for “gripping”, yet release easily with minimal adhesion (F_{\perp} \approx 0.34 \text{ N/cm}^2) and friction (F_{\parallel} \approx 0.38 \text{ N/cm}^2) forces. Furthermore, when actuated for “gripping”, yet release easily with minimal adhesion (F_{\perp} \approx 0.34 \text{ N/cm}^2) and friction (F_{\parallel} \approx 0.38 \text{ N/cm}^2) forces during detachment or “releasing”, over multiple attachment/detachment cycles, with a relatively small normal preload of 0.16 N/cm^2 to initiate the adhesion process (Pesika, et al., 2013; Holbrook, et al., 2013). The possessions of Gecko hierarchical structures, i.e., the feet, toes, setae, and spatula, which are the corresponding models to establish the mechanical concerned in Gecko-inspired surfaces. Moreover, the structures with physically powerful adhesion forces, high ratio of adhesion and confrontation forces that exhibits in anisotropic hierarchical structures. That can leads to directional adhesion and friction through this attachment system and thus detachment motions persist (Pesika, et al., 2013; Holbrook, et al., 2013).

**Nanomaterials of Gecko**

Therefore, all above study clearly denote that the principle, materials in Gecko are nonmaterial’s which posses a single unit size (in at least one dimension) between 1 and 1000 nanometers (10^{-9} meter). It is usually 1-100 nm. Nanomaterials with structure at the nanoscale often posses optical, electronic or mechanical properties. The structure of foraminifera and viruses (capsid), the wax crystals covering a lotus or nasturtium leaf, spider and spider-mite silk, the "spatulæ" on the bottom of Gecko feet, some butterfly wing scales, natural colloids (milk, blood), horny materials (skin, claws, beaks, feathers, horns, hair), paper, cotton, nacre and corals also posses optical electronic properties (Bhattacharyya and Debnath, 2008; Eldridge, 2014; Bhattacharyya, et al., 2015). Moreover, our own bone matrix are natural organic nanomaterials (Bhattacharyya and Debnath, 2008; Eldridge, 2014; Bhattacharyya, et al., 2015). There are certain nanomaterials which may consider as fullerenes. The fullerenes are a class of allotropes of carbon which theoretically are graphene sheets rolled into tubes or spheres. (Bhattacharyya, et al., 2011; Bhattacharyya, et al., 2012). These include the carbon nano tubes (orsilicon nanotubes) which are of interest both because of their mechanical strength and also because of their electrical properties (Bhattacharyya, et al., 2009). Thus the nanoparticles are of different forms which we have previously mentioned and others nanomaterials are e.g. quantum dots, nanowires and nanorods etc. Nanoparticles or nanocrystals completed with metals, semiconductors, or oxides which are of fastidious for their mechanical, electrical, magnetic, optical, chemical and other important property (Cristin, et al. 2007). Nanoparticles are of great scientific attention as they are successfully introduced a bridge between bulk materials and atomic or molecular structures (Chakravarthy et al., 2012; Sukul, et al., 2009). The high surface area containing nanoparticles are exceptional and can take part in diverse important functions. This nanomaterials can be synthesis by two means like, Bottom up and Top down method. In recent decade steadily it is understandable that the arbitrary use of nanomaterials exhibit a risk factor (Huber, et al., 2005). It is very motivating to mention here that
the water contain nano-fabrillar polymers have been made-up with combination of colloidal nanolithography, deep-silicon etching, and nano moulding to pretend to be the nanostructure of Gecko foot-hairs (Kustandi, et al., 2007). Furthermore, Gecko’s simulated surface characteristics densely packed polymeric nanofibrils (250nm) with super-hydrophobic nature which is water-repellent and “easy-to-clean” the surface through the thump pad. Through the macroscopic scale of Gecko, the nano structured facade can stick on tightly to a even glass substrate and come into the use for self-cleaning possessions of the seta nanostructures. The packed polymeric nano fibrils (250nm) with super-hydrophobic nature which are usually found on the surface of the thump pad can carry out its functions with the help of Van der Waals Forces. The highest adhesion forces are encounter in Geckoes feet, which are involved in hierarchical structure consisting of toes (millimetre dimensions), lamella (400–600 mm size), setae (micrometre dimensions) and spatula (w200 nm size) (Cao, et al., 2015). Adhesion forces of setae on dissimilar substrates have been measured by a micro-electromechanical arrangement practice. The atomic force
microscopy clearly propose that the adhesion force of the Gecko’s add-on system is reproducibly found to the concerning system that is about 10 nN. Thus the new glow on the nano-mechanisms are the add-on of Gecko’s pad which will help to think a based on reason to design a artificial attachment systems. With the expansion of nanotechnology mechanism in Gecko, a synthetic nano adhesive tape, called Gecko Tape (Figure 6) has been developed in the present century (Minsky and Turner, 2015). This is a new skill expectant for the stickiness of the feet of the wall-climbing lizard-and it’s a new implement for industrial and/or manufacturing engineers (Lan and Pinnavaia, 1994; Salahuddin, et al., 2002).

Mussels which are well known for Gecko’s aptitude to cling on wet surface and also can tidy away specific adhesive proteins containing a high content of the catecholic amino acid 3,4-dihydroxy-L-phenylalanine (DOPA) which can help brawny adhesion power of the setae. It has been found that the mussel glue has the ability to stick on almost all surfaces of the pads. It has also been bring into creature that an iron complex ([Fe(AdopaTP)3]) was the key curative agent in this adhesive and the iron centre is synchronized by three DOPA residue(Lan and Pinnavaia, 1994; Salahuddin, et al., 2002). A

**Proposed mussel adhesive metal-protein cross-link**

It may state here that on inorganic surface, the unoxidized DOPA formed high-strength up till now which reversible with synchronization bonds (Minsky and Turner, 2015). While on unprocessed surfaces, oxidized DOPA was competent to adhere via covalent bond arrangement process (Figure 3) (Lan and Pinnavaia, 1994; Salahuddin, et al., 2002).


Polymer System like mimetic- polymer system maintain the Gecko’s adhesive arrangement process where over a thousand polymers get in touch with cycle process, like, in both dry and wet environment. Naturally, pull on and off of the pads may perform by the biochemical bonding process (
Gecko - Nanotechnology

Gecko’s toes possess more than billion minute adhesive hairs which are about 200 nanometers size. The spatula-shaped hairs of Gecko are in direct earthly contact with environment. The spatula-shaped fibres are significant for strong adhesion (Minsky and Turner, 2015).

Figure 8. The nanoscale fibrillar structures in the hairy attachment pads of beetle, fly, spider and Gecko. The density of surface hairs increases with the body weight of animal, and the gecko has the highest density among all animal species. (Image has adopted from Max Planck Institute for Metals Research/Gorb). Nanoscale contact optimizes adhesion. Optimal adhesion of geckos and insects based on shape optimization and contact surface size reduction, report Max Planck researchers in Stuttgart, Germany, May 25, 2004

Thus the key result of the above discussion is that there continue to exist 100 nanometers nanomaterials on the Gecko’s pad. The wide-ranging optimal adhesion can be accomplished by amalgamation of size reduction and shape optimization process. Moreover, smaller the size of pads exhibits the less importance of the shape. This consequence provides a authentic explanation for the distinguishing size of hairy add-on systems in biological process which falls in a tapered range, flanked by a few hundred nanometer to a few micrometers. Consequently, it is obvious at the present that a few helpful approach arrived for conniving bonding agent developed through engineering method which we have discussed above in the text (Lan and Pinnavaia, 1994; Salahuddin, et al., 2002; Minsky and Turner, 2015).

Gecko and also lots of insects have adopt nanoscale fibrillar structure on their feet as adhesion modus operandi. Thus adhesion between a single fibre and a substrate may expand by van der Waals force (as we have discussed before) or by electrostatic exchanges. Therefore Geck’s healthy pads intend of optimal sticking together (rough and smooth) at nanoscale which provides a reasonable account for the convergent evolution of hairy addition systems in biological process (Gao and Haimin, 2004; Guo, et al., 2015)

APPLICATION OF GECKO SETAE

Synthetic setae

Therefore we can put forward that the setae found on the toes of Gecko and several methodical investigate in this area is resolute in the direction of the progress of synthetic setae production, akin to in Gecko’s pad. The five toed feet of a Gecko are covered with flexible hairs called setae and the tresses of hairs are split into nanoscale structure called spatula. Subsequent discovery of the
Gecko’s adhesion device have been the major topic of the current research effort. These development are balanced to yield novel adhesive materials with better properties which are probable to locate in different industrial sectors, like, defence, nanotechnological industry, healthcare and sports (Autumn, et al., 2000). It is fascinating to propose that "gecko tape" has been experienced by attach a sample to the hand of a 15 cm high plastic Spider-Man figure weighing 40g, which can make possible it to stick to a glass ceiling. (Murphy, et al., 2005; Lee, et al., 2007).

**Synthetic gecko foot hair**

![Synthetic gecko foot hair](image)

**Figure 9.** Showing Scanning electron microscope images of Nanotube Synthetic Gecko Foot Hair vertically aligned multiwalled carbon nanotube structures: Transferred into a PMMA matrix and then exposed on the surface (#25 mm) after solvent etching with a rate of 0.5 mm min. Adopted from Betul Yurdumakan, Nachiket R. Raravikar, Pulickel M. Ajayan and Ali Dhinojwala (2005). Synthetic gecko foot-hairs from multiwalled carbon nanotubes. Chem. Commun., pp. 3799–3801.

As nanoscience and nanotechnology develop by the scientists are now ready to produce synthetic carbon nanotubes (CNTs) by chemical vapour deposition onto quartz and silicon substrates (Figure 9) which could support a shear stress of a Gecko foot. This process will help in human health care in future. (Yurdumakan, et al., 2005).

**Geckel**

The geckel is describe to be an collection of Gecko-mimetic, about 400 nm wide silicone pillars and fabricate by large electron rays lithography. It posses a layered of mussel-mimetic polymer—poly(dopamine methacrylamide-comethoxyethylacrylate)-p(DMA-co-MEA), a mussels containing synthetic form of the catecholic amino acid 3,4-dihydroxy-l-phenylalanine. The new glue material does not only depend on Van der Waals forces for its adhesive properties but also relies on the chemical interaction of the surface with the hydroxyl groups which are present in the mussel proteins. The advantage of this complex material improves adhesion power in wet and dry, Therefore, it can use in bandages and medical tape in future (Guo, et al., 2015).

**ROBOTICS**

**The development of scansorial robotics:**
Primarily, we will try to find out, differentiate and implement of the dynamics of climbing phenomena (wall reaction forces, limb trajectories, surface interactions, etc). Secondly, a design, fabricate and deploy adhesive patch technology that yield appropriate adhesion and friction properties to make possible essential surface connections (Yurdumakan, et al., 2005; Lee, et al., 2007). In the present decade, robotics, research has begin to focal point on developing robust climbers. Various robots have been developed that climb flat vertical surfaces using suction, magnets, and arrays of small spines, which attach their (robust climbers) feet to the surface. In addition, two actuators on each hip drive a four bar device, which is converted to foot motion along a prescribed trajectory process. The positions and plane of the four bar mechanism angularly with respect to the platform. The word RiSE robot comes from a Czech word,
The word robot first appeared in a 1920, projected by Czech writer Karel Capek, *R.U.R.: Rossum's Universal Robots* (Rieder, 2010). A mechanical machine that from time to time resemble with human activity and is competent of performing a assortment of multifaceted human every day jobs on order or by being planned advance (Bartlett, 2015).

An appliance or device that operates automatically or by remote control. A person who works mechanically without original consideration, especially one who respond robotically to the orders of others (Davis, 1994; Bartlett, 2015). A robot can be controlled by a human operator, sometimes from a great distance (Crew, 1995; Bartlett, 2015). An autonomous robot acts as a stand-alone system, absolute with its own computer (called the controller). Additionally, insect robots work in fleets ranging in integer from a few to thousands, with all fleet members under the supervision of a single controller. The term insect arises from the similarity of the system to a colony of insects, where the persons are simple but the fleet as a whole can be sophisticated (Ford, 2015). Robots are sometimes grouped according to the time frame in which they were first widely used (Rieder, 2010). Third-generation robots can be stationary or mobile, autonomous or insect type, with sophisticated indoctrination, speech recognition and/or synthesis, and other superior character (Ford, 2015). If we consider the fourth-generation robots which are in the research-and-development stage and comprise character such as artificial intelligence, self-replication, self-assembly, and nanoscale size (physical dimensions on the order of nanometers, or units of $10^{-9}$ meter) (Bartlett, 2015; Ford, 2015). Some advanced robots are called androids because of their superficial similarity to human beings (Bartlett, 2015; Ford, 2015). Androids are mobile, usually moving around on wheels or a track drive (robots legs are unstable and difficult to engineer). The android is not necessarily the end point of robot evolution. Some of the most esoteric and powerful robots do not look or behave anything like humans (Bartlett, 2015; Ford, 2015). The ultimate in robotic intelligence and complexity might take on form, yet to be imaginary shape. At long last, trends in the rates of progress in robotic research for getting the final product where the robotic legs will get the greater adhesive power (Bartlett, 2015; Ford, 2015).

Thus the RiSE robot to succeed in climbing in both natural and man-made environments. The RiSE robot does not but will use dry adhesion in combination with spine. More recently, robots have been developed that utilize synthetic adhesive materials for climbing smooth surfaces such as on glass (Bartlett, 2015; Ford, 2015). The crawler and climbing robots can be used in the military context to examine the surfaces for aircraft defects and are starting to replace manual inspection methods. Today’s crawlers helps in the use of vacuum pumps and heavy-duty suction pads (Yurdumakan, et al., 2005; ; Murphy, et al., 2005; Lee, et al., 2007; Bartlett, 2015; Ford, 2015).

**Stickybot**

Newly achieved robot called Stickybot which uses synthetic setae in order to scale even extremely smooth vertical surfaces just as a Gecko proceed (Autumn, et al., 2000; Autumn, 2006). The necessary ingredient of the Stickybot are as: hierarchical compliance for conforming at centimetre, millimetre and micrometer scales, anisotropic dry adhesive materials, so that individual can control adhesion by domineering shear and lastly dispersed active strength control that works with compliance and anisotropy to achieve stability process (Yurdumakan, et al., 2005; Murphy, et al., 2005; Bartlett, 2015; Ford, 2015).

**Geckobot**

Another similar example is "Geckobot" developed for climbed at angles of up to 60° from Gecko
limbs (Yurdumakan, et al., 2005; Murphy, et al., 2005; Bartlett, 2015; Ford, 2015).

**Joint replacement**
Adhesive based on artificial setae that have been projected as a resources of picking up, moving and align subtle parts such as ultra-miniature circuits, nano-fibres, nanoparticles, microsensors and micro-motors (Autumn, 2006). In the macro-scale surroundings, they could be applied directly to the surface of a product and replace joints based on screws, rivets, conventional glues and interlocking tabs in manufactured goods. In this way, both assembly and disassembly processes would be simplified. It would also be beneficial to replace conservative adhesive with synthetic Gecko adhesive in void environment (Sethi, et al., 2007).

**Other Applications of Synthetic Setae on Gecko Concept**
Other applications of synthetic setae, on Gecko concept have been projected, like , Fumble-free football gloves, High-grip vehicle tires, Training shoes and revolutionary rock climbing aids (Autumn, et al., 2000; Autumn, 2006).

**In Nut Shell of Bumpy Surfaces of Gecko**
More interesting to propose that each lizard's foot posses half a million hairs, which are one-tenth of the thickness of a human hair. Their ends are multiply tattered. At the frayed ends which are spatula-shaped structures (about a billion per Gecko) (Gamble, et al., 2012). In this case the pointed tip of a typical shaft of hair can make get in touch with only a small surface area. Moreover, a tip shaped like the flipper piece of a spatula can compress over bumpy surface and increase the area with which the hair can make contact (Alyssa, et al., 2014). Large exterior area is important because of the individual forces accountable for Gecko adhesion. The previous support from above helps to consider that every functional aspect of bumpy surfaces hairs of Geckos pad can act through a *Vander walls* forces. Thus Geckos will fasten to metal, plastics or glass, in air or under water. A diminutive number of scientist predict that the force of a single Gecko foot hair posses the adhesive force of a whole body of Gecko and dividing that by the number of foot hairs per animal. Naturally, Geckos on four different surfaces ranging from hydrophilic (glass), intermediately wetting (PMMA), hydrophobic (OTS-SAM–coated glass), and finally PTFE, a hydrophobic surface to which Geckos fail to adhere in dry conditions. (Yi, et al., 2014; Palmero, 2015; Wasay and Sameoto, 2015; Coxworth, 2015)

**Gecko in Biomedical Application**
Gecko’s bio medical proprietary skill platforms are fully synthetic bio inspired light-activated tissue adhesives with strong adhesive and sealing capacity. As we know that the adhesives have unique chemical and physical properties, including high stickiness, hydro-phobicity and on demand curative. These features allow delivering through plainly invasive procedures to demanding wet environments, with no obligation for tissues drying prior to adhesive application. Gecko’s adhesives are fully biodegradable, biocompatible and elastic, complying with the softness and dynamics of underlying tissues (Coxworth, 2015).

**CONCLUSION**
Observing quite a lot of studies focused on the Nano- micro and whole-animal mechanics of Gecko adhesion on clean and dry substrates, we have acquainted with relatively little about the effects of water on Gecko adhesion process. Many Gecko species can navigate in rainfall surface area. Adhesive abilities of Geckos are the results of one key factor that is due to *Vander walls* forces. Dry adhesive fibres of styrene ethylene butylenes styrene that encircle the gasket which helps to generate a mushroom shaped geometry and act as a sweep to identify the path of the needed channel. Apart from acting as sidewalls, these fibres enhance the net of adhesion and contribute to make the whole geometry tolerant due to imperfection and surface variation. Gecko’s feet are able to stick...
to surfaces on the basis of millions of microscopic hair-like projection recognized as setae. These temporarily tie with surfaces at a molecular level, due to Van der Waals forces. It is obvious to propose that the reptiles pull their feet forward with breaking the biochemical bonds. Moreover, the current form of the mechanism both in and outside of a annulled attaining an adhesive force of over one Newton per square centimetre on smooth surfaces. What's more, it's still able to maintain that recital after 1,000 cycles. It is the uniqueness of Gecko. It is extraordinary study of a unassuming lizard is causal to considerate the elementary process- underlying in adhesion and friction process.

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