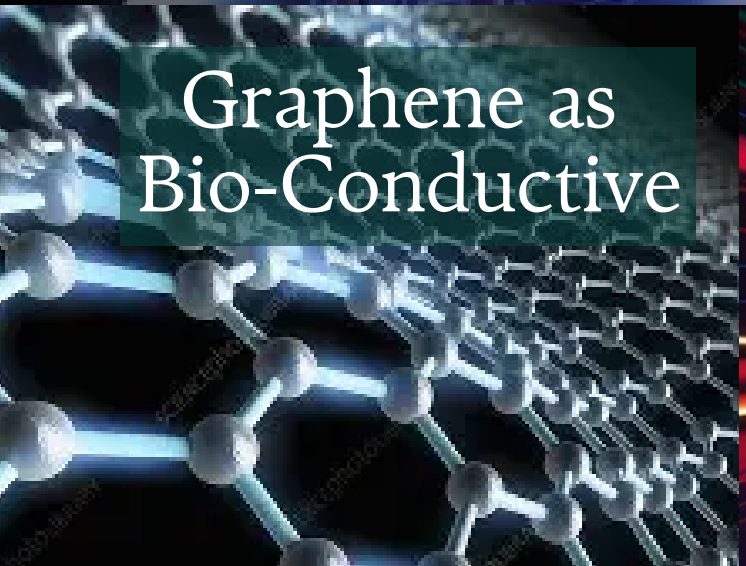
Dreamarks

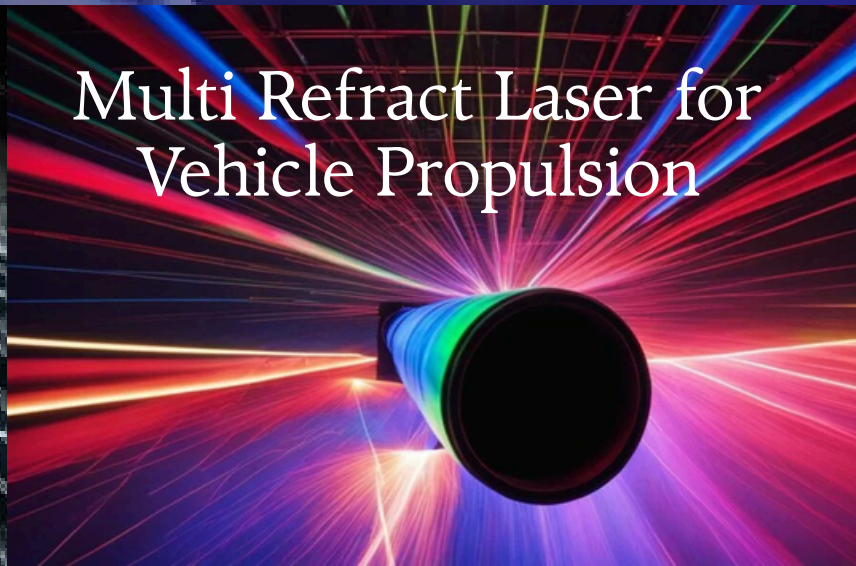
OCT 2025 | ISSUE NUMBER 12

MAGAZINE

Understanding Our Bio-Psychology Realms



Graphene as Bio-Conductive



Multi Refract Laser for Vehicle Propulsion

IN THIS ISSUE

Dreamarks Magazine

About Dreamarks

Gina Al ilmi
Sole Writer, Books Author, Conceptor
Graphic & Web Designer
Founder & Director of Dreamarks

Address : Bogor, West Java, Indonesia
www.dreamarks.com
gina@dreamarks.com
@dream.pathways

Bio-Psychology Realms Unmasked

Everyone of us have the capability to think, to reason, to made decision, to analyze, to comprehend everything that are matter to us. Many people are interested in developing their child brain by giving them the milk that are enriched by serial process of fortifications. But not many of us realized that we also have enormous potentials within ourselves to be developed by relearning many subjects that they have previously studying at our school age.

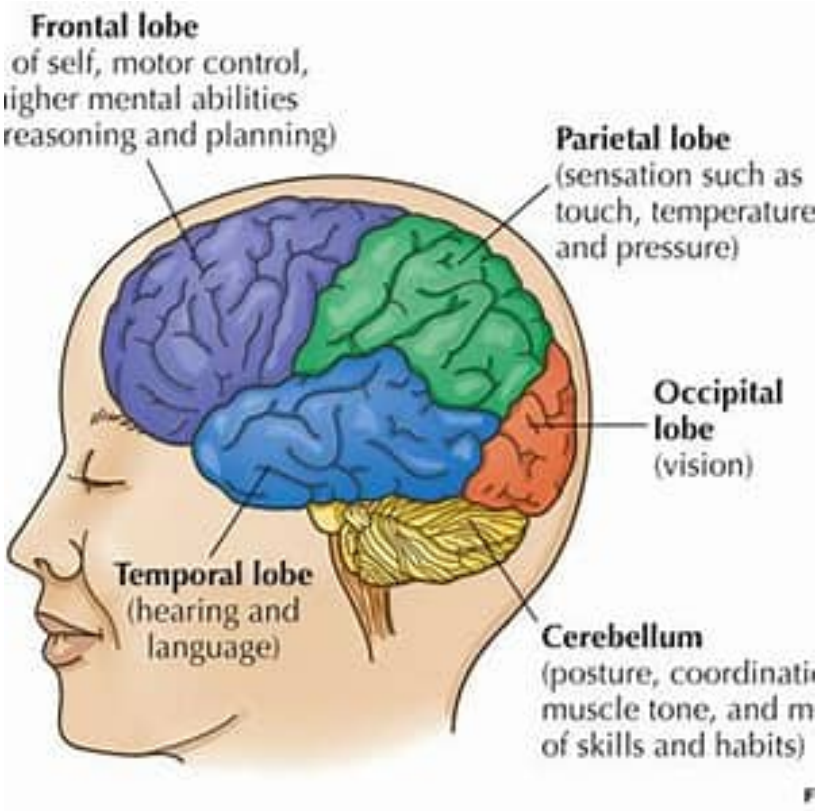
When we finishing college and get a degree, that doesn't mean that our learning process ifinish or to ended. When we entering the field of work by using the intellectual capability that we has had, what we have to do then is to do more learning, to be able to grow in our careers.

It is when we're not stop to learn, then our success begun. As for this reason, why this magazine, books and websites of Dreamarks are made, and being spread globally. Our bio-physical as one human race has shape this beautiful planet earth. Anyone from the medieaval age if they can be awaken in this age will say WOW to everything they see and met.

The shape of humankind and human kindness today, has developed far upon what has developed 500 years ago. Though we still have to face many terrible things happening in our nations, or in another part of the globe, it is the spread of kindness and the support for one nation to another, that embodied the structure of The World Peace that everyone dreaming of

Gina Al Ilmi

Editor-in-Chief



How Our Cerebrum Works Every Day

The brain is divided into several regions, each responsible for different functions:
Frontal Lobe, Parietal Lobe, Temporal Lobe, Occipital Lobe, Cerebellum, Brainstem
These regions work together to regulate everything from movement and memory to emotions and sensory processing.

Frontal Lobe: (front part of our brain)

1. Involved in decision making,
2. problem solving,
3. control of purposeful behaviors,
4. consciousness, and
5. emotions.

Temporal Lobe (at the below side of our brain)

1. Responsible for processing auditory information
2. important for memory
3. important for speaking, reading, writing (any kind of language).

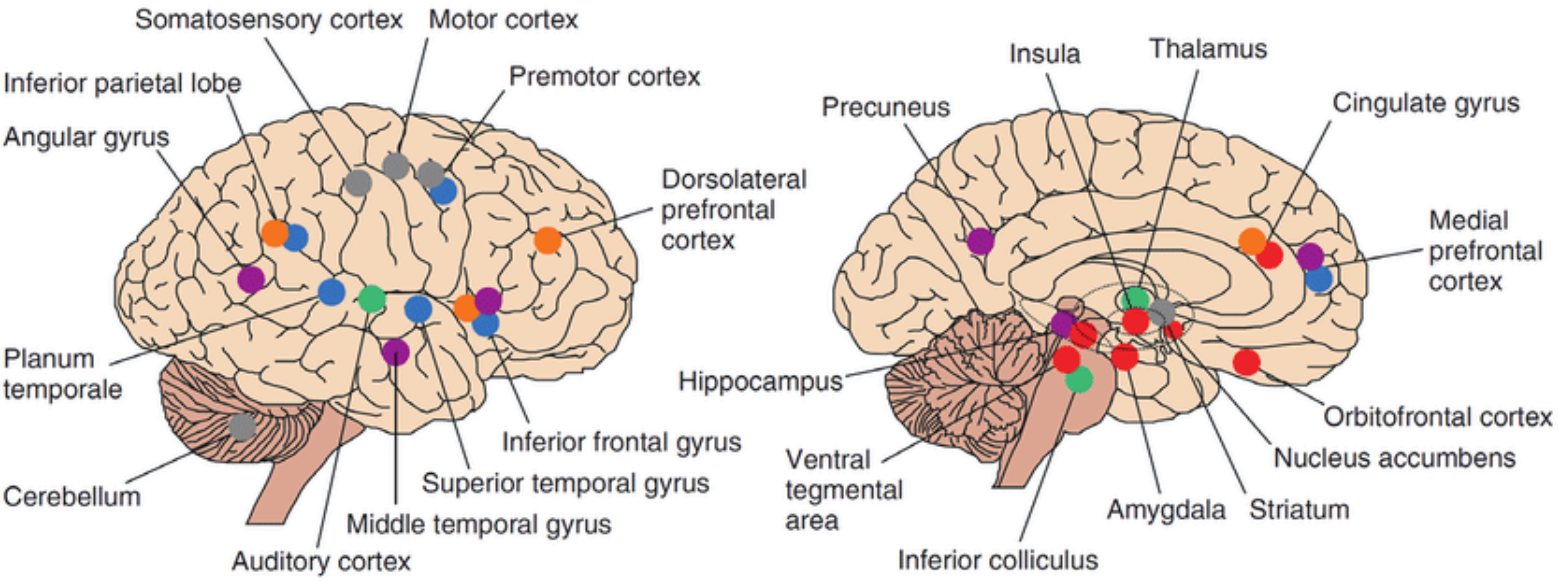
Occipital Lobe (at the back of brain)
Primarily responsible for analyzing what we see (visual processing)

Cerebellum (the little part of the brain)
1 Coordinates balance and
2. fine motor skills such as writing, drawing, painting, cooking, designing, typing, crafting, moulding, operating

Parietal Lobe: (side upper part of our brain)

1. Processes sensory information
2. involved in spatial orientation
3. directions and motoric navigation

Brainstem (the tubular shape part below our brain)
Controls automatic functions such as breathing, heart rate, and blood pressure.



How Our Brain Region Processing Music

- Auditory Cortex
- Inferior Colliculus
- Thalamus

Perceiving the basic acoustic features of music (e.g., frequency, duration, loudness)

- Inferior Frontal Gyrus
- Planum Temporale
- Premotor Cortex
- Inferior Parietal Lobe
- Medial Prefrontal Cortex

Perceiving higher-order musical features, such as harmony, intervals, rhythm

- Inferior Frontal Gyrus
- Singulate Gyrus
- Inferior Parietal Lobe
- Dorsolateral Prefrontal Cortex

Focusing and keeping track of music in time (attention and working memory)

- Angular Gyrus
- Middle Temporal Gyrus
- Inferior Frontal Gyrus
- Precuneus
- Medial Prefrontal Cortex
- Hippocampus

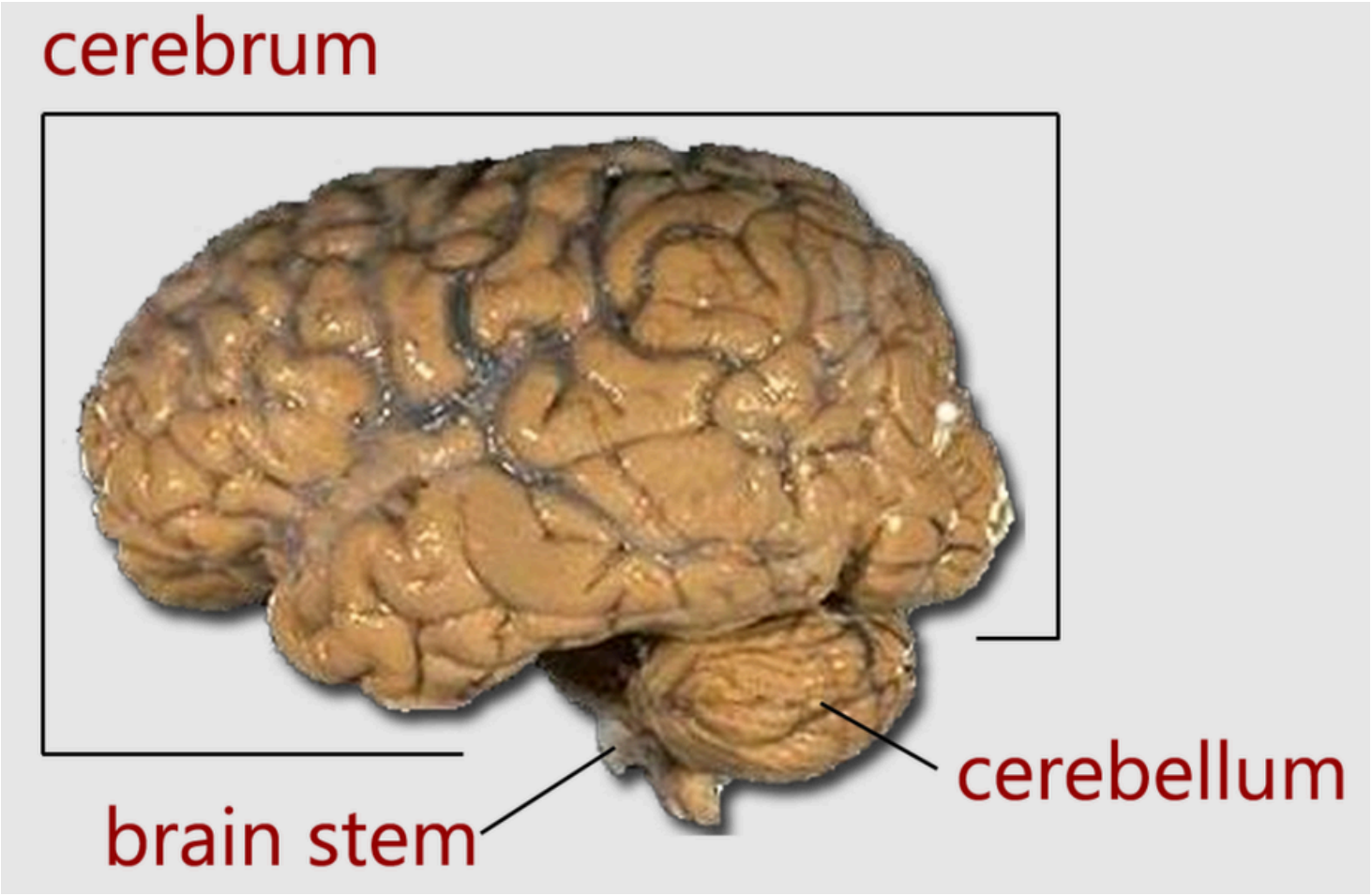
Recognizing music, recalling associated memory (episodic memories)

- Somatosensori Cortex
- Motor Cortex
- Premotor Cortex
- Cerebellum
- Striatum

Playing, singing, moving to the beat of music (motor functions)

- Singulate Gyrus
- Orbitofrontal Cortex
- Nucleus Accumbens
- Amygdala
- Ventral Tegmental Area
- Hippocampus

Music-Evoked Emotions and experiencing pleasure and reward



How Our Cerebellum Works Everyday

- Cerebellum

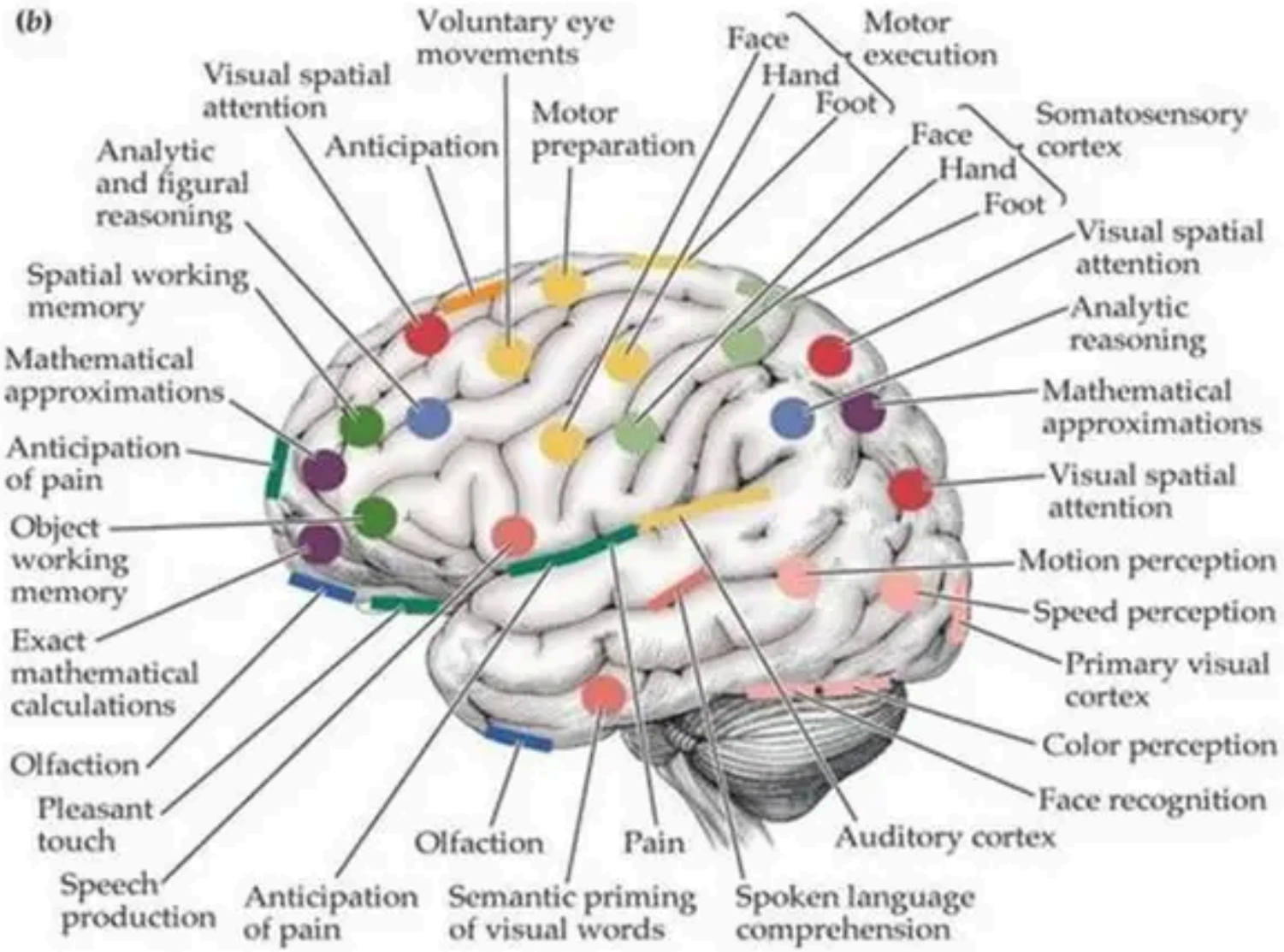
Description: Located under the cerebrum, it is smaller but contains a high density of neurons.
Functions: Coordinates voluntary movements, balance, and posture. It plays a role in motor learning and fine-tuning movements.

- Brainstem

Description: Connects the cerebrum and cerebellum to the spinal cord and consists of the midbrain, pons, and medulla oblongata.
Functions: Controls basic life-sustaining functions such as heart rate, breathing, and sleep cycles. It acts as a relay station for signals between the brain and the body.

- Limbic System

Description: A complex system of structures located beneath the cerebrum, including the hippocampus and amygdala.
Functions: Involved in emotion, memory, and motivation. It plays a crucial role in forming memories and emotional responses.



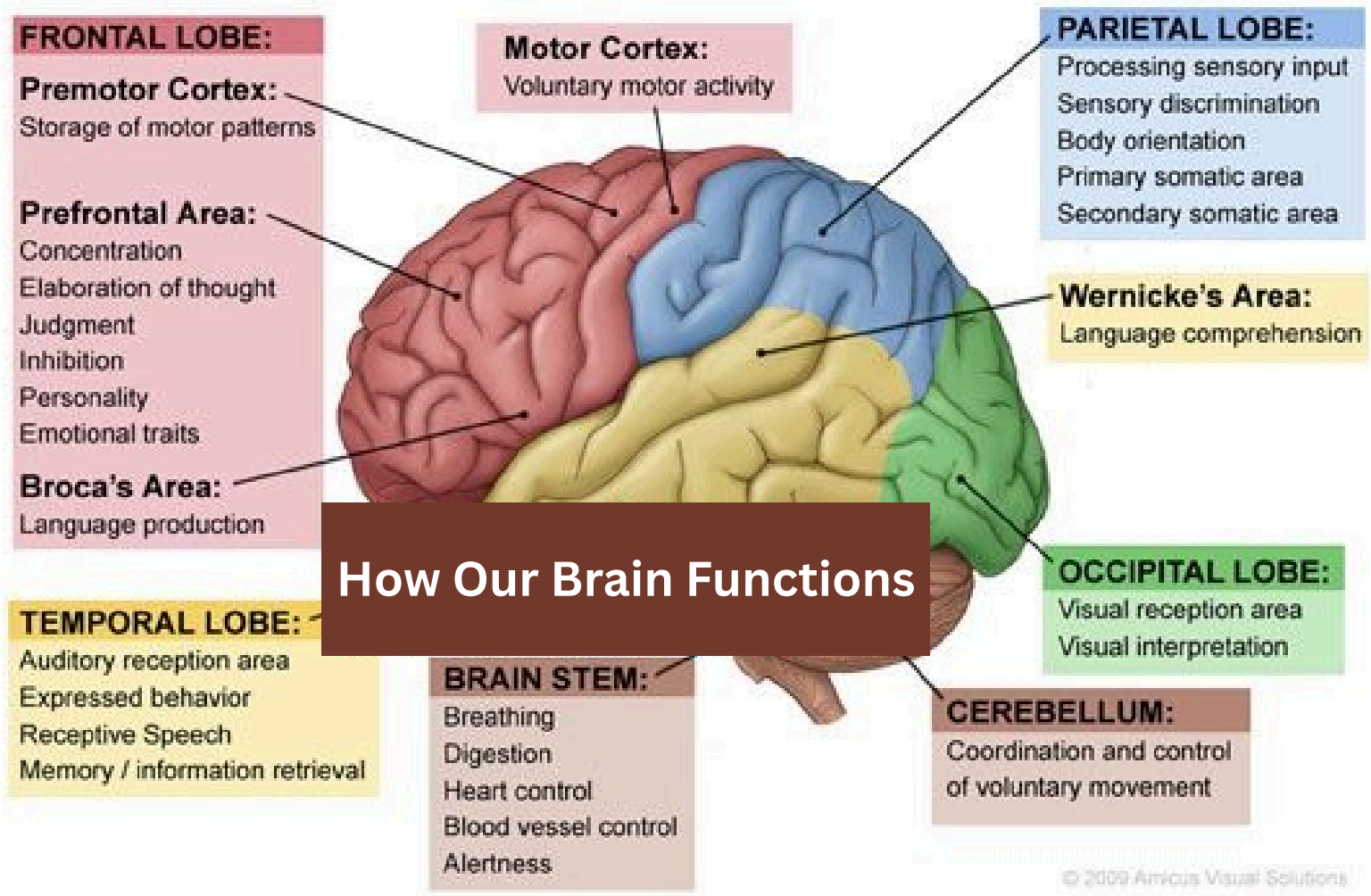
How Proximity Principles Works in Learning

Our brain also working based on the proximity of the regions. When we learning, have you ever or maybe oftentimes experiencing some sort of pain or headache when studying maths? Apparently, the locations for the sensors of pain anticipation is located in frontal cortex, located near with the brain parts that is processing mathematical exact calculations, and also the part that processing mathematical approximations.

The pain-related experience area also happens for the brain region that in charge for speech productions, that are also located near the regions that anticipating pain, and also for the brain region that responsible for the real pain sensation. The location for motor executions are also near it, that's why we often experiencing that our hand, foot and face are affected by our wryness when we give speech in front of many people.

Not only when giving speech, this brain region also active every time we talk to other people. That's why we often experience excessive sweat on our face, hand and foot and even our auditory cortex becoming more sensitive when actively communicating with many people at once. That happened because our brain region that in charge for spoken language comprehension are located near the brain region that hold the part for pain anticipating.

How you anticipate something? The brain region that are active for the anticipating an action or facing other, is located at the posterior (upper cortex) of our brain. With the brain region for visual spatial attention that are close to our Voluntary eye movement. Which means, when we anticipate something, our eye calculated everything together with the region that are doing visual spatial attention and our body are in the ready mode by analyzing how our motoric action will be given.



How Our Brain Functions Every Day

The brain is working interconnectedly, in these different regions shown above. When we try to concentrate, we usually touch our forehead. That exactly the place of Prefrontal area that have the functions to help us concentrates, doing elaboration of thought, perceiving psychological cues, or judging the perception that we perceive.

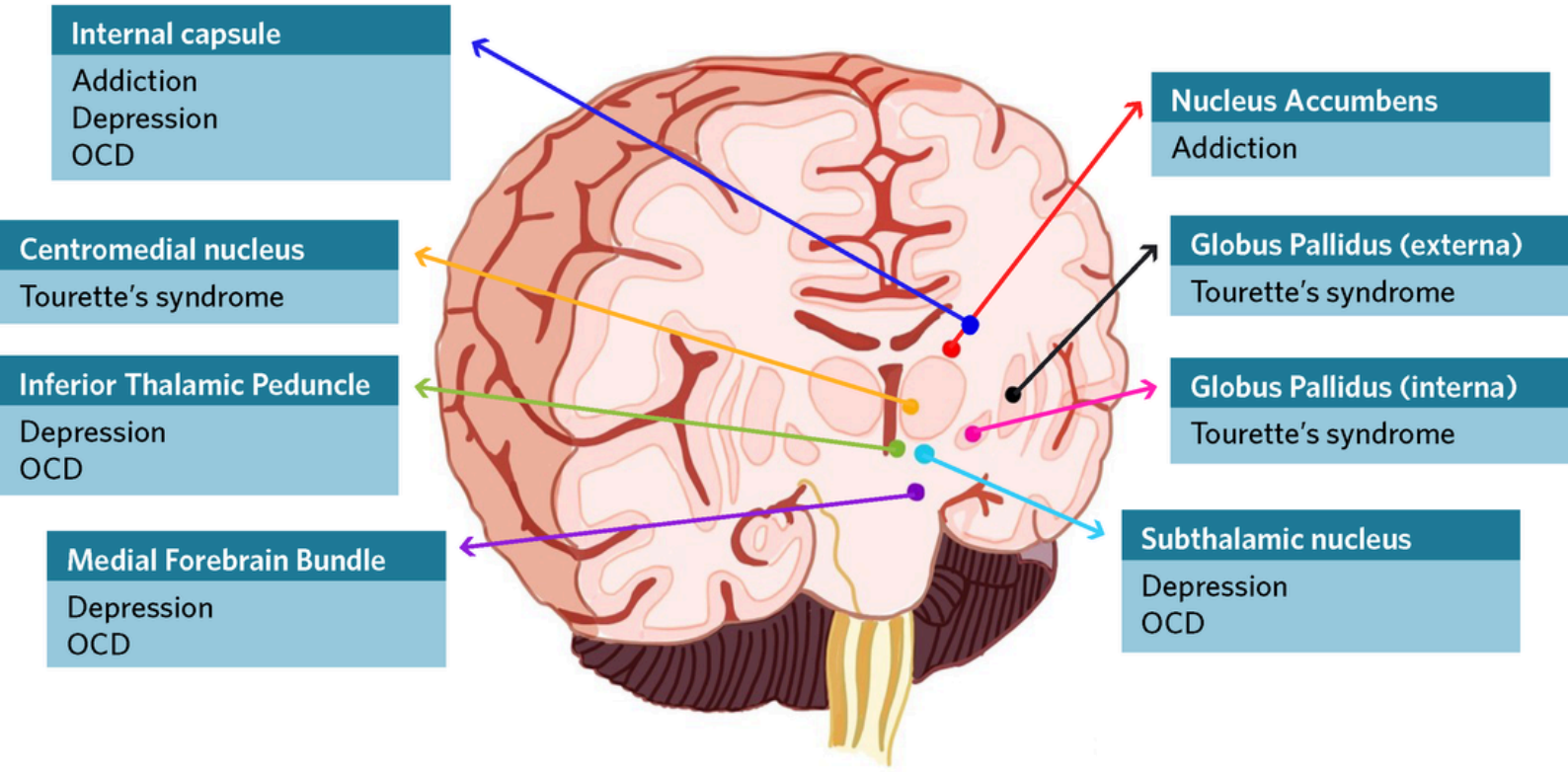
This prefrontal area also has the ability to calm us down, as it has the functions for inhibition, and shaping our personality. This prefrontal area also hold the functions of expressing our personality, as the prefrontal are in charge for regulating our emotional expression, or to omit the expression. This most frontal area of our brain are shaping our inherit emotional traits.

Right in the back of prefrontal cortex, there's the Temporal Lobe that has the capability for auditory reception area, as its located behind our ears. Temporal Lobe is audio receptor area. Solely in charge in how we expressed our behavior when we are hearing something. In example, when we talk, there are Receptive Speech when we say something upon answering what we hear. In this area, we are also connecting memory and information retrieval.

This means that everything we remember are also influencing how we answer to other people attitude and questions. One of the most serious damage can happened in this area if there's concussion or head injury, in this area, our memory will be largely expected and we're loosing many memories because of the traumas. In this region, there's wernicke's area, the center of language comprehension, that is very important in learning and studying.

At the back of our head, there are occipital lobes. This region of the brain is responsible for visual perception and visual interpretations. That is why when we fall and our head hit the hard floor, we can experiencing loosing sights for several minutes until our brain fastly recovering after we have our balance back to stand in our feet.

Not only our brain has their own tasks, they are also responsible for creating ideas, doing imaginative task, and structurizing our comprehension into meaningful knowledge.



Psychiatric Disease Ablation Targets

Brain Ablation That Causing Psychiatric Diseases

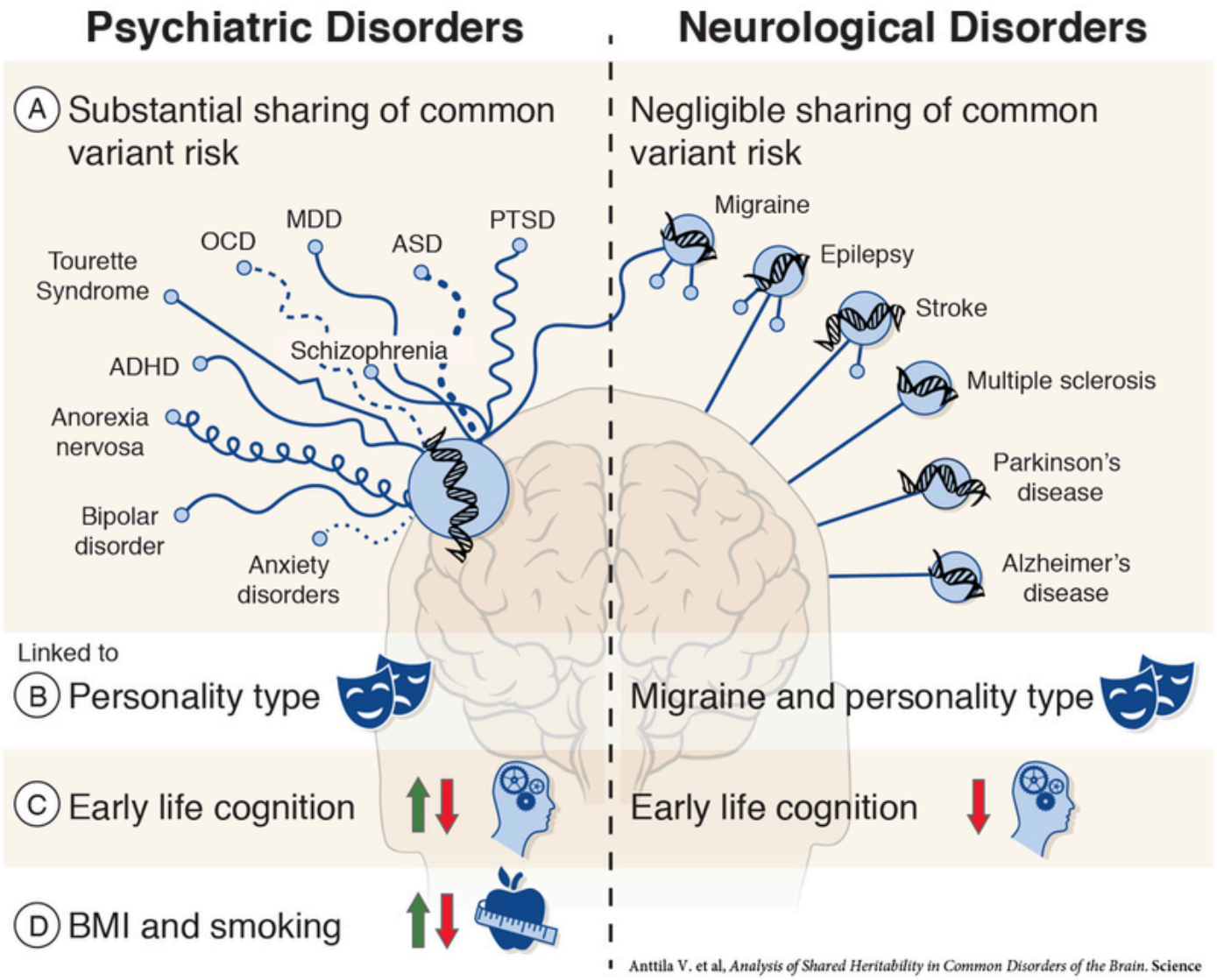
The image above are figuring how certain place in brain, can cause serious psychiatric diseases if there's ablation happening. The picture of sliced brain above showing the ablation at the medial forebrain bundle, and the subthalamic nucleus ablation can cause Depression and Obsessive Compulsive Dissorder (OCD).

Brain ablation at the The Inferior Thalamic Peduncle and at the internal capsule can also causing addictions, and also depression, and OCD. The ablation are affected to the hormone release that becoming abnormal.

The brain chemical levels that releasing abnormal hormones then disrupting the neural firing from one brain region to the other, creating cognitive declining, and if this doesn't treated with the proper psychiatric medicine, can create severe hallucinations and disrupting our daily task and annoying us when we are working on serious problems and have to handle hard subjects.

The task of this large brain middle cerebrum areas are affecting the specific tasks of many peripheral brain regions. Causing the visual rendering that then creating fake images. Not only that, the hallucination then creating fake memories of anything that are not realistically happened. This is the reason why brain ablations that is not treated are severely damaging to our emotional controls, and annoyed us in doing our daily tasks.

These disorder of the intellectual functions are happening because of these brain ablations. Just like a disease at our heart, lungs or hepar, these bio-psychology root cause of psychiatric disorder must also treated by timely medicinal supports that has to be consume according to the perscriptions for daily intake.



Anttila V. et al, *Analysis of Shared Heritability in Common Disorders of the Brain*. Science

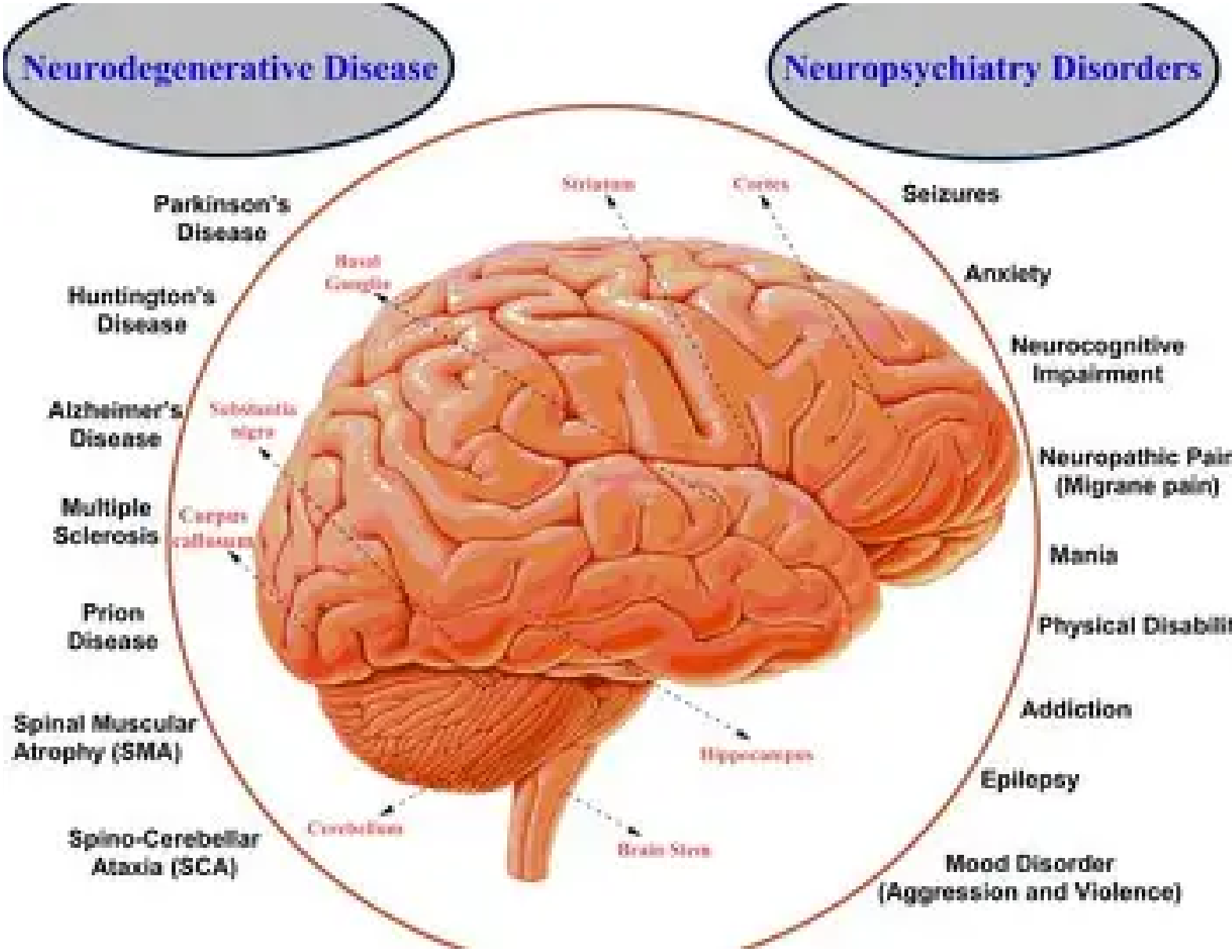
Differentiating Psychiatric and Neurological Dissorders

Schizophrenia is not a single symptom, it involving other type of mental dissorder. Different with other tipe of disease or dissorder, Mental Dissorder are conditions that cannot be fully healed.

Mental disorders are also always change forms and can change to other type of dissorder. In example, college depression can change form and switch into the bipolar symptoms, and after several months it can change form into catatonia or switch to schizophrenia. While neurological dissorder are not like it.

Stroke, Alzheimer, Parkinson, Migraine, and Epilepsy are happened also because of the ablation of certain spot at the brain regions. But this conditions of disorder are not affecting the self awareness and self acceptance of a person.

Because self awareness and self acceptance are the two factors that build healthy cognition and intelectuality. If people with psychiatric syndromes are recepting the right medicine and the proper treatment, their brain conditions can be better then before. Many people with bipolar conditions and even schizophrenia can function at maximum level and reaching many accomplishments. Such as President Winston Churchill and Prof John Nash. They both from britain and they are not only succeded in becoming President or Professor, both of them also books author that are worthy to receiving nobel prize. Not only had Dyslexia, Churchill Bipolarity and Nash's Schizophrenias are not making them feel beat up by the tragic life they had experiencing.



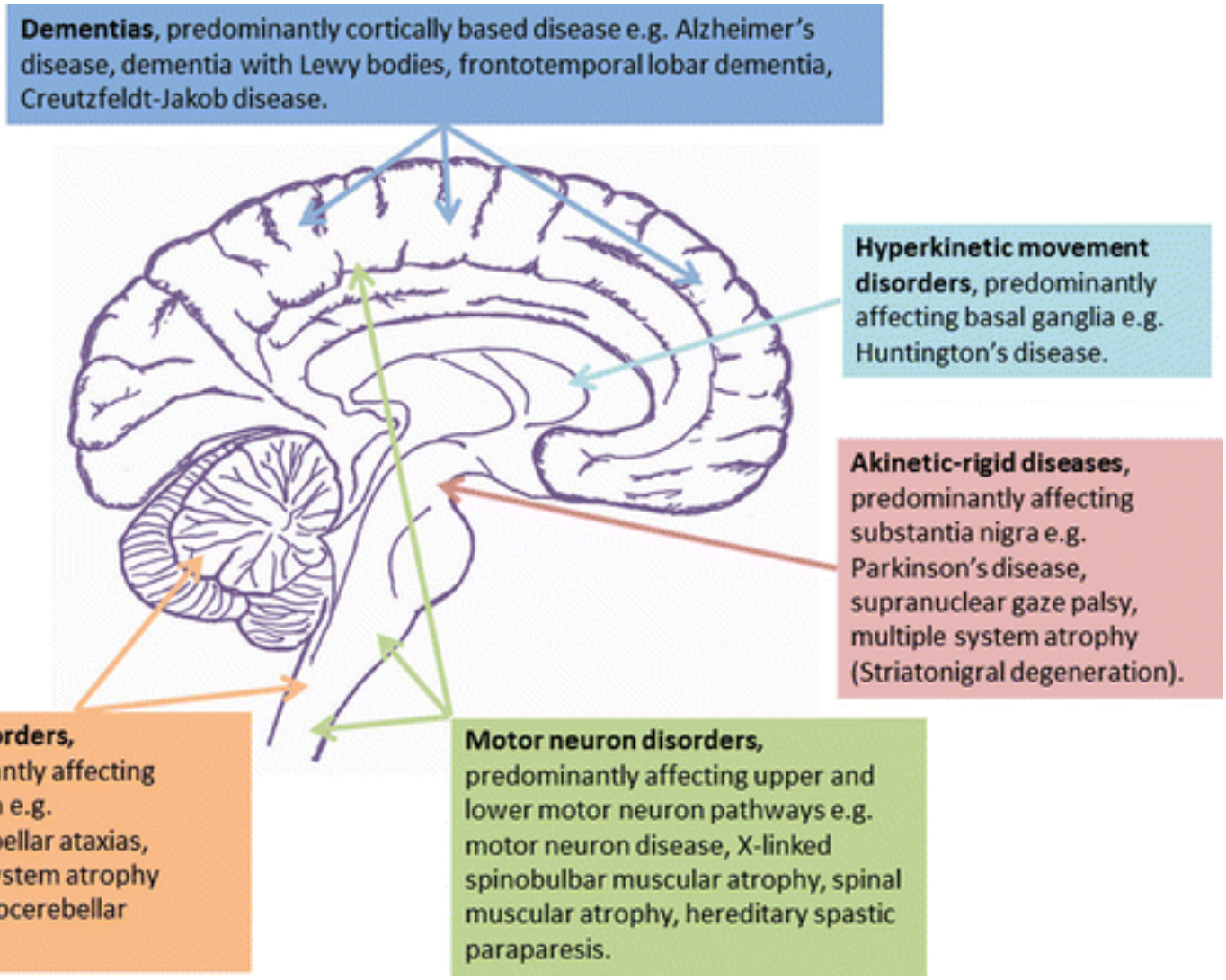
Differentiating Neuro Degenerative & Psychiatric Disorder

Differentiating between neurodegenerative and psychiatric diseases involves understanding their unique characteristics and how the symptom interact with each other symptom disorder. Neurodegenerative diseases, such as Alzheimer's and Parkinson's, involve the gradual loss of neurons and their connections, leading to cognitive and motor dysfunction. Psychiatric disorders, on the other hand, affect mood, cognition, and behavior, often with symptoms like depression, anxiety, and psychosis.

Both types of diseases share some overlapping mechanisms, such as neuroinflammation and oxidative stress, and can have similar symptoms, particularly in their late stages. However, they also have distinct features that can help differentiate them. For instance, neurodegenerative diseases often present with cognitive decline and motor impairments, while psychiatric disorders may show symptoms like mood swings, anxiety, and changes in personality.

Early intervention and personalized treatment strategies are crucial for managing both types of diseases. Understanding the complex interplay between these conditions can lead to better outcomes and quality of life for patients and their families.

Within neurodegenerative diseases, it is estimated that 55 million people worldwide had dementia in 2019, and that by 2050 this figure will increase to 139 million people.



Neuro Degenerative Dissorder Symptom Interactions

The greatest risk factor for neurodegenerative diseases is aging. Mitochondrial DNA mutations as well as oxidative stress both contribute to aging. Many of these diseases are late-onset, meaning there is some factor that changes as a person ages for each disease. One constant factor is that in each disease, neurons gradually lose function as the disease progresses with age.

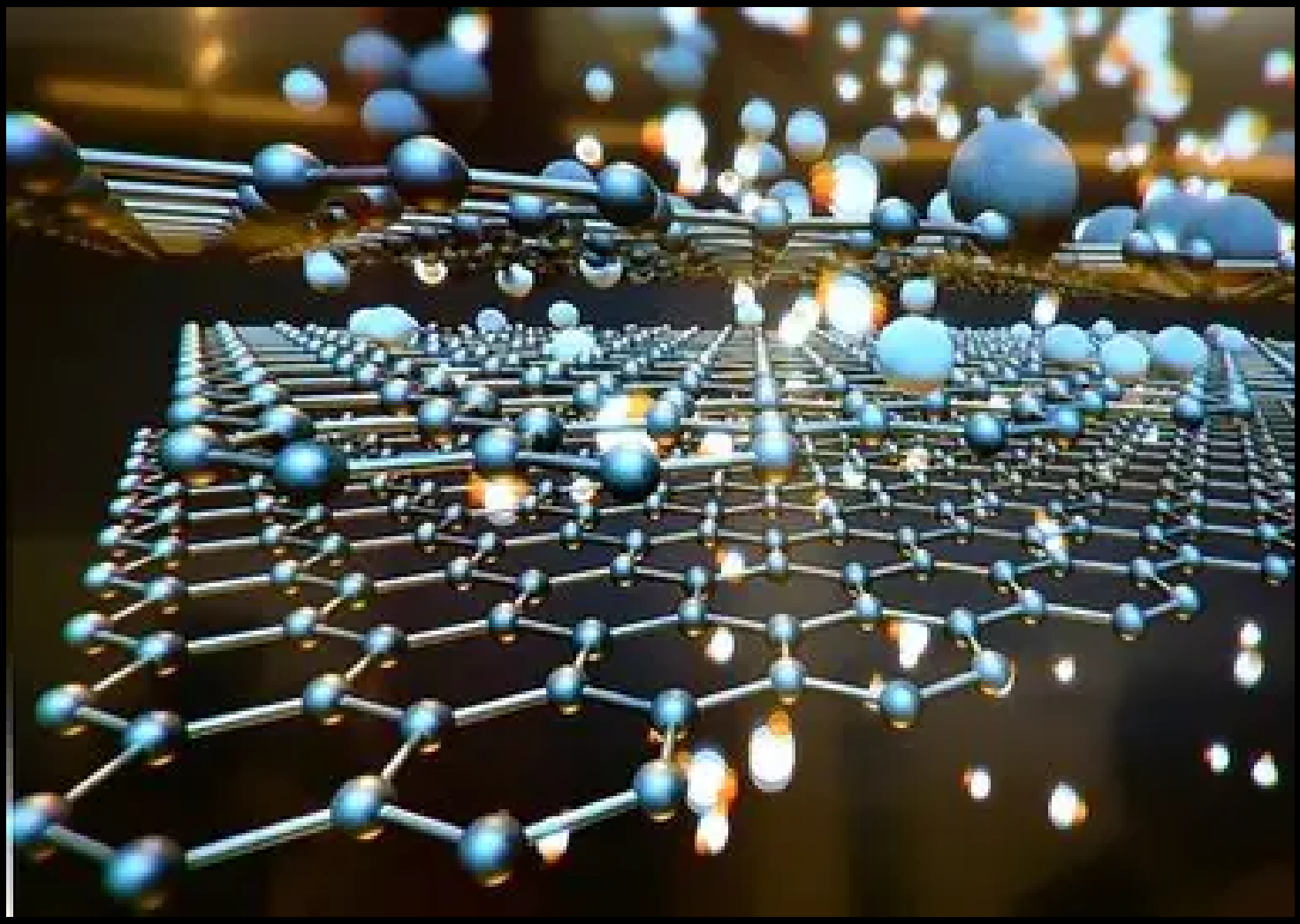
It has been proposed that DNA damage accumulation provides the underlying causative link between aging and neurodegenerative disease. About 20–40% of healthy people between 60 and 78 years old experience discernable decrements in cognitive performance in several domains including working, spatial, and episodic memory, and processing speed.

Brain Infection is also can be the cause of neuro-degenerative diseases. A study using electronic health records indicates that 45 (with 22 of these being replicated with the UK Biobank) viral exposures can significantly elevate risks of neurodegenerative disease, including up to 15 years after infection.

Parkinson's disease and Huntington's disease are both late-onset and associated with the accumulation of intracellular toxic proteins. Diseases caused by the aggregation of proteins are known as proteopathies, and they are primarily caused by aggregates in the following structures:

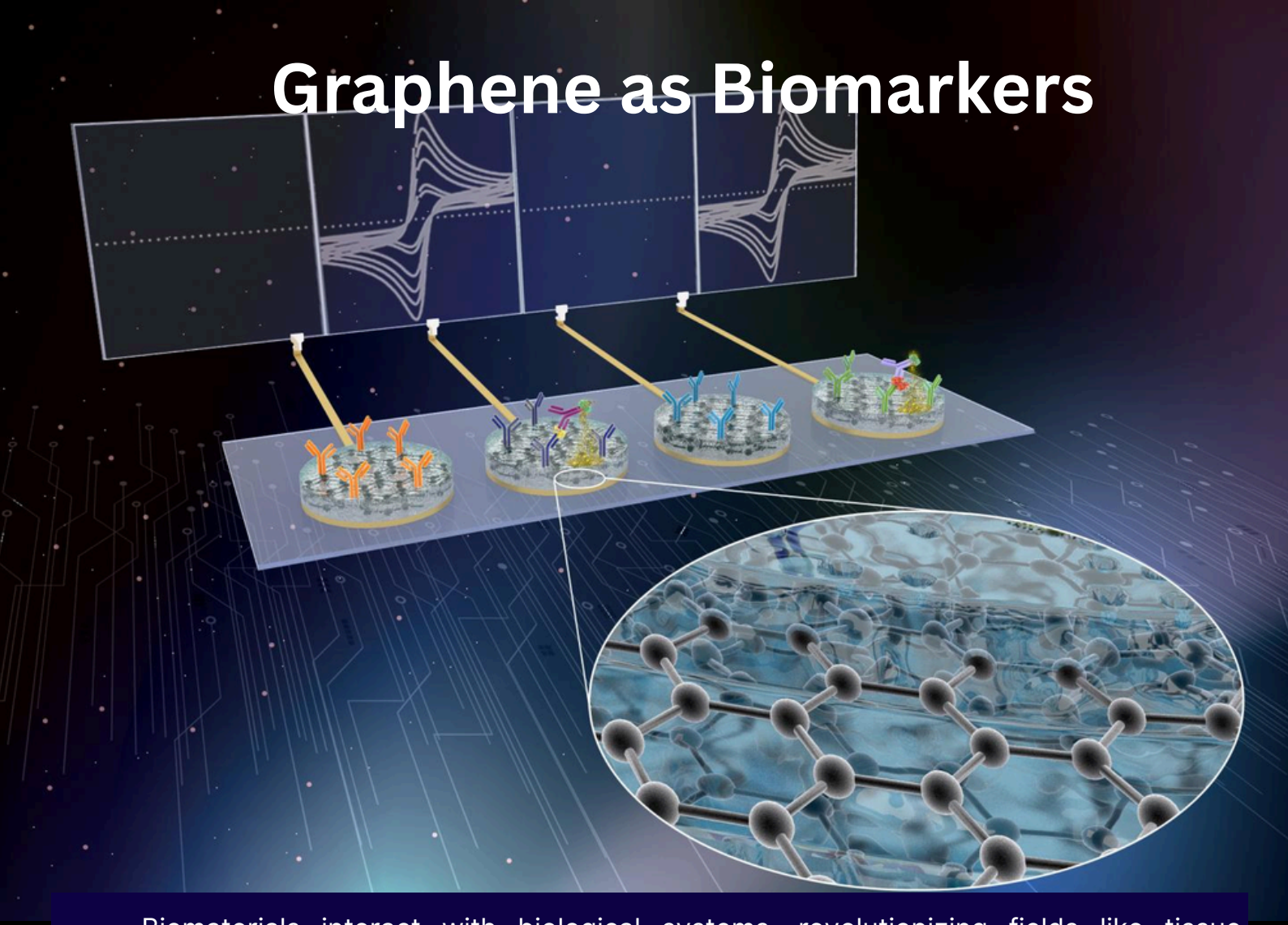
- cytosol, e.g. Parkinson's and Huntington's
- nucleus, e.g. Spinocerebellar ataxia type 1 (SCA1)
- endoplasmic reticulum (ER), (as seen with neuroserpin mutations that cause familial encephalopathy with neuroserpin inclusion bodies)
- extracellularly excreted proteins, amyloid-beta in Alzheimer's disease

Graphene as Bio-Conductive & Biomarker



Graphene's unique properties make it a valuable material for bioconductive applications. Its one-atom-thick, sp2-bonded carbon structure provides high tensile strength, large surface area, stability, and elasticity. These characteristics lead to exceptional conductivity, rapid electron transfer, and high adsorption potential, making graphene valuable in catalysis, energy storage, and material synthesis. In biomedicine, graphene's targeted surface immobilization, efficient drug loading, and high biocompatibility enhance applications in drug delivery, biosensing, and antimicrobial coatings. Despite the promise of graphene-based materials, challenges remain regarding their biodegradability and environmental impact. To address these challenges, increasing application of sustainable synthesis from organic sources is taking place, offering renewable solutions with high porosity, structural configurability, and surface functionality.

Graphene as Biomarkers

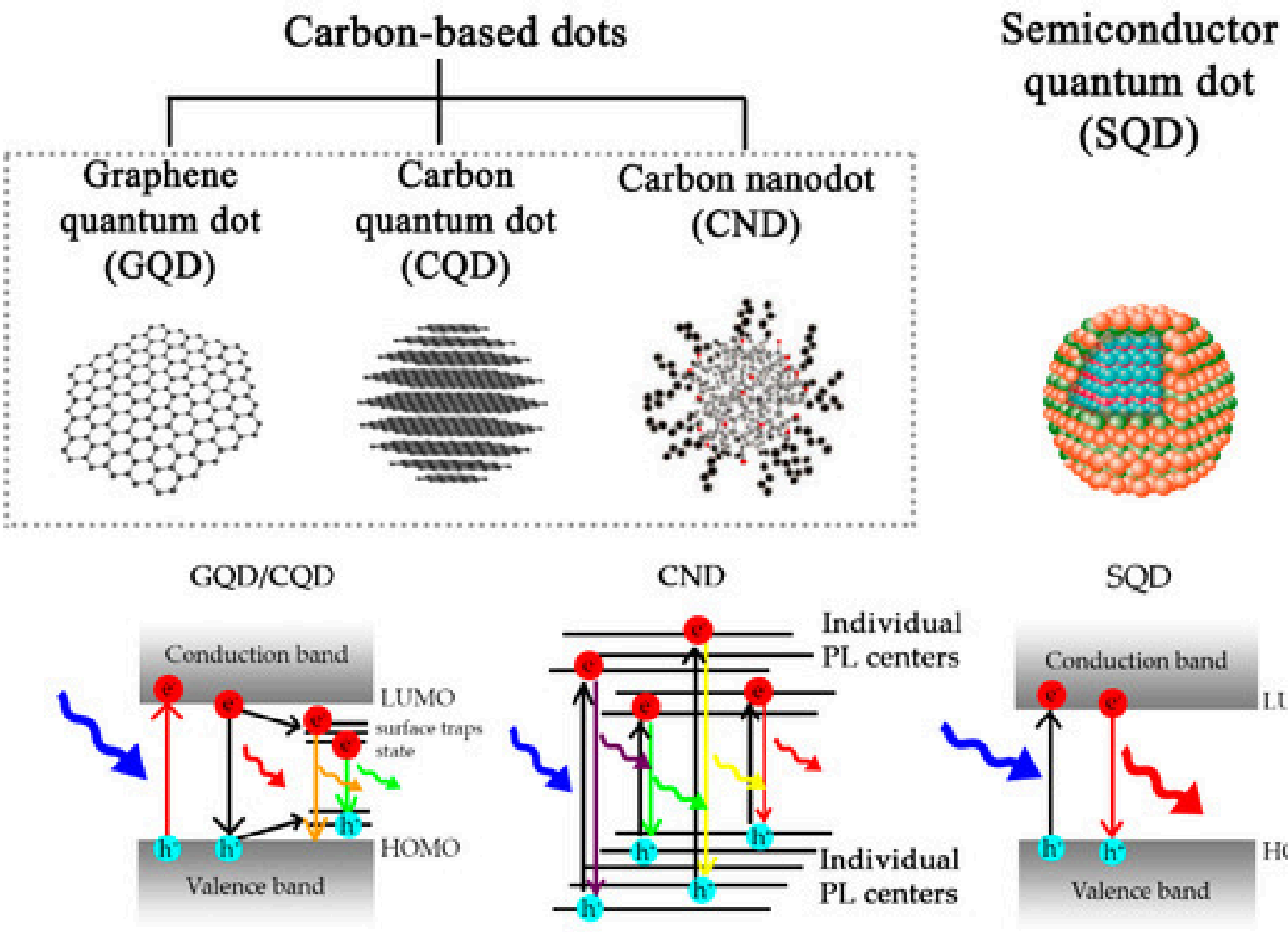


Biomaterials interact with biological systems, revolutionizing fields like tissue engineering, drug delivery, and implant development due to their biocompatibility and structural adaptability. However, concerns about the sustainability of their synthesis and sourcing drive the search for eco-friendly alternatives.

Fortunately, carbonaceous materials, particularly graphene and its derivatives, have emerged as promising candidates. Graphene's one-atom-thick, sp^2-bonded carbon structure provides high tensile strength, large surface area, stability, and elasticity. Its derivates share similar extended characteristics. These properties lead to exceptional conductivity, rapid electron transfer, and high adsorption potential, making graphene valuable in catalysis, energy storage, and material synthesis.

In biomedicine, their targeted surface immobilization, efficient drug loading, and high biocompatibility enhance applications in drug delivery, biosensing, and antimicrobial coatings. Despite the promise of graphene-based materials, challenges remain regarding their biodegradability and environmental impact. To this effect, increasing application of sustainable synthesis from organic sources is taking place, enhancing their value as viable alternatives.

They can be synthesized from plant extracts, agro-residues, and bio/food waste, offering renewable solutions with high porosity, structural configurability, and surface functionality. This chapter explores carbonaceous biomaterials in-depth, examining their structure, functionality, and diverse biomedical applications. Through a comprehensive analysis of recent advancements and prospects, the chapter aims to highlight the pivotal role of graphene-based biomaterials in advancing biomedical research and catalyzing healthcare innovations.



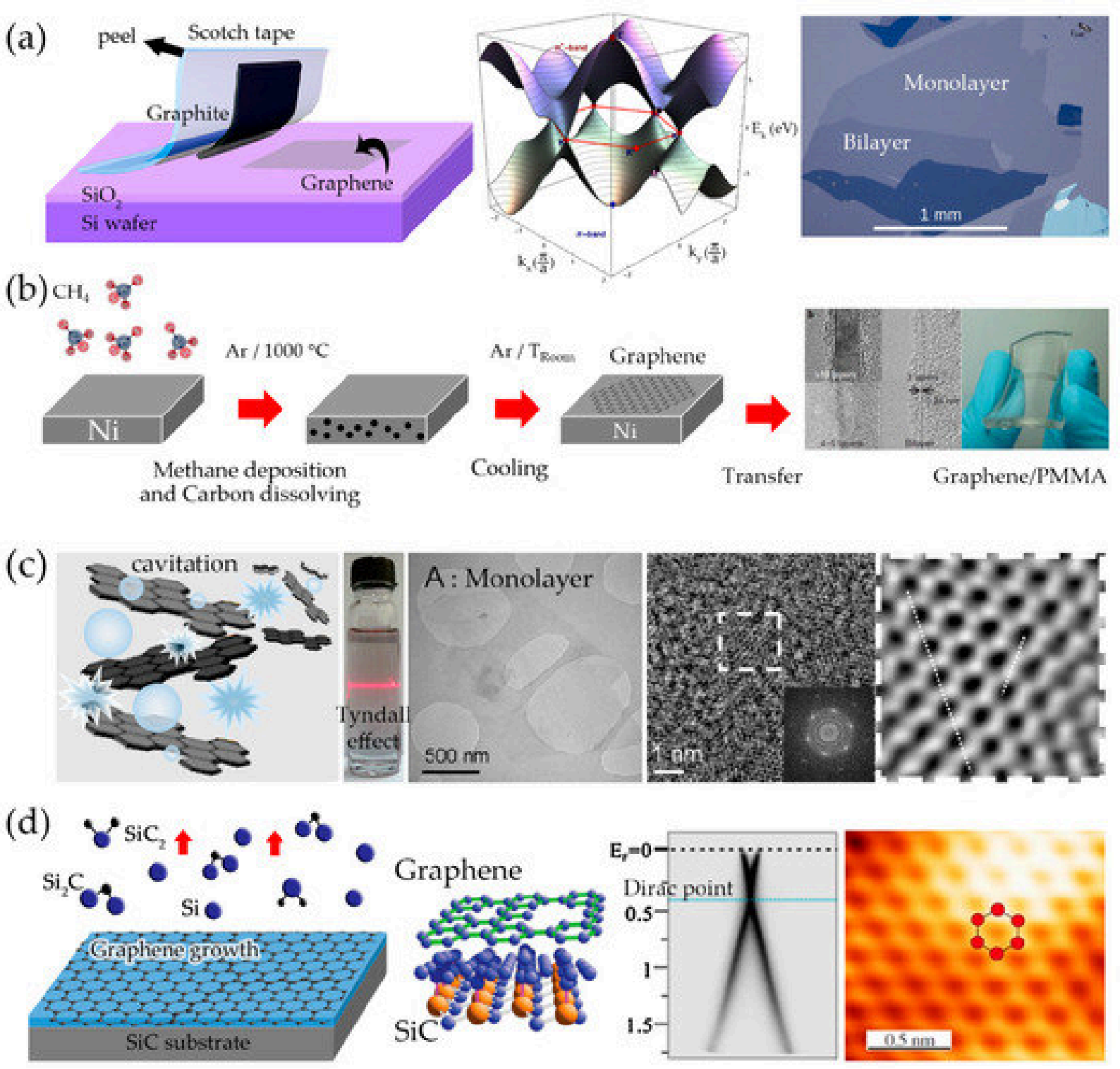
Graphene as Bio-Conductor

Wounded and dysfunctional Organs are now can be treated with 3D bioprint technology. Starting from basic additive manufacturing (AM) to precise biomaterial and cell deposition for skin reconstruction. Special focus is given to bioinks, including natural polymers, synthetic hydrogels, decellularized extracellular matrix (dECM), and composite formulations, all designed to mimic native skin properties.

These different kind of 3D bio printing model are in line on development, whether it is the infection models, multi organ models, the multipose of diabetes models, the muscle models and the neural tissue models. All these 3D bio printing models of application, can generally increase the chance for every patient to be cured from many of what priorly can't be cured. Imagine the new world when we don't have to wait for organ donors, and the immense health derived from the DNA specific bio-printing technology.

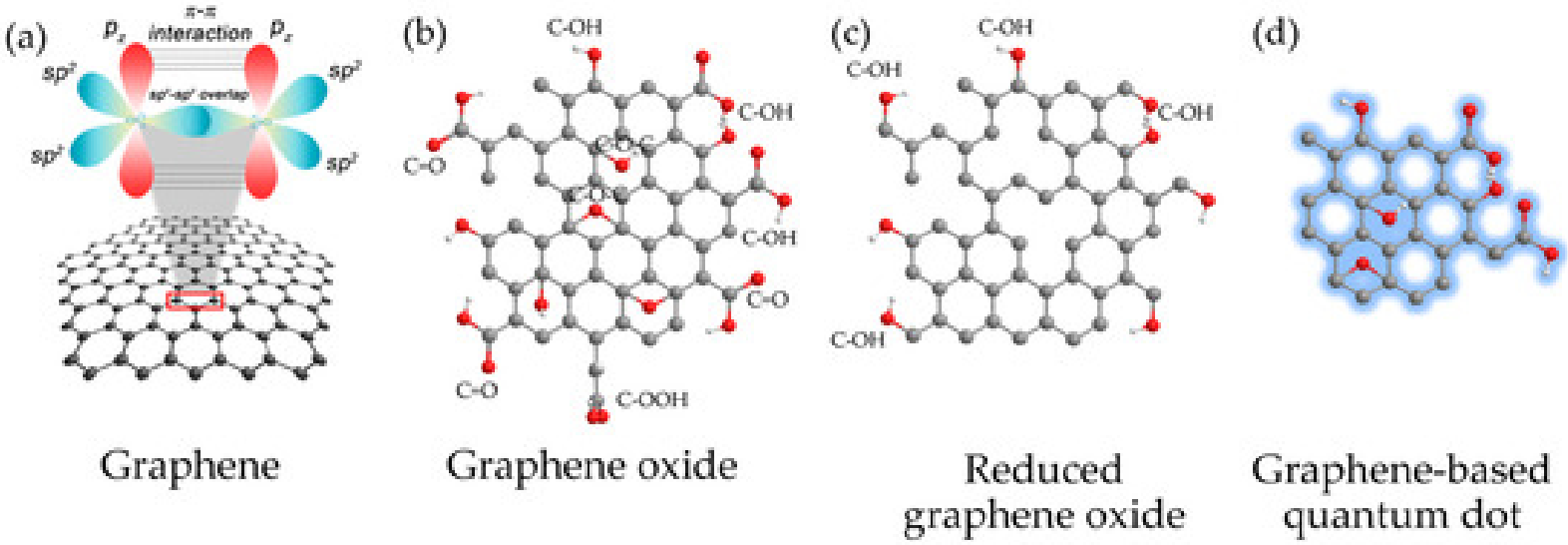
The emerging field of 4D bioprinting is highlighted, incorporating smart, stimuli-responsive materials capable of dynamic structural and functional adaptation to complex wound environments. Key cellular components and bioprinting techniques for multilayered constructs are reviewed, along with personalized approaches such as in situ handheld bioprinting and artificial intelligence (AI) assisted bio-fabrication.

Still, many challenges are faced in clinical translation, manufacturing, and scalability are addressed, with future perspectives on the normatic and frontier of 4D usage of robotics, AI, and innovative biomaterials in regenerative wound care.



Several Techniques of Graphene Synthesis

Several techniques of graphene synthesis:
(a) graphene sheet is left on top of a silicon oxide wafer exfoliated by scotch-tape technique, its electronic band structure, and the real monolayer and bilayer graphene;
(b) Large scale process of graphene growth using (chemical vapor deposition) CVD and the transferred graphene to poly(methyl methacrylate) (PMMA)
(c) Liquid exfoliation of graphene showing crystalline honeycomb pattern on the exfoliated layer
(d) epitaxial graphene growth on a silicon carbide (SiC) by sublimation of Si atoms and the structural characteristic of the monolayer graphene.



Structures of graphene-based materials show (a) the pristine graphene (pure-arranged carbon atoms) with sp_2-hybridized carbon atoms, and the chemically modified graphene, including (b) graphene oxide (GO); (c) reduced graphene oxide (RGO) and (d) graphene quantum dot (GQD).

The Evolution of Graphene for Bio Usage

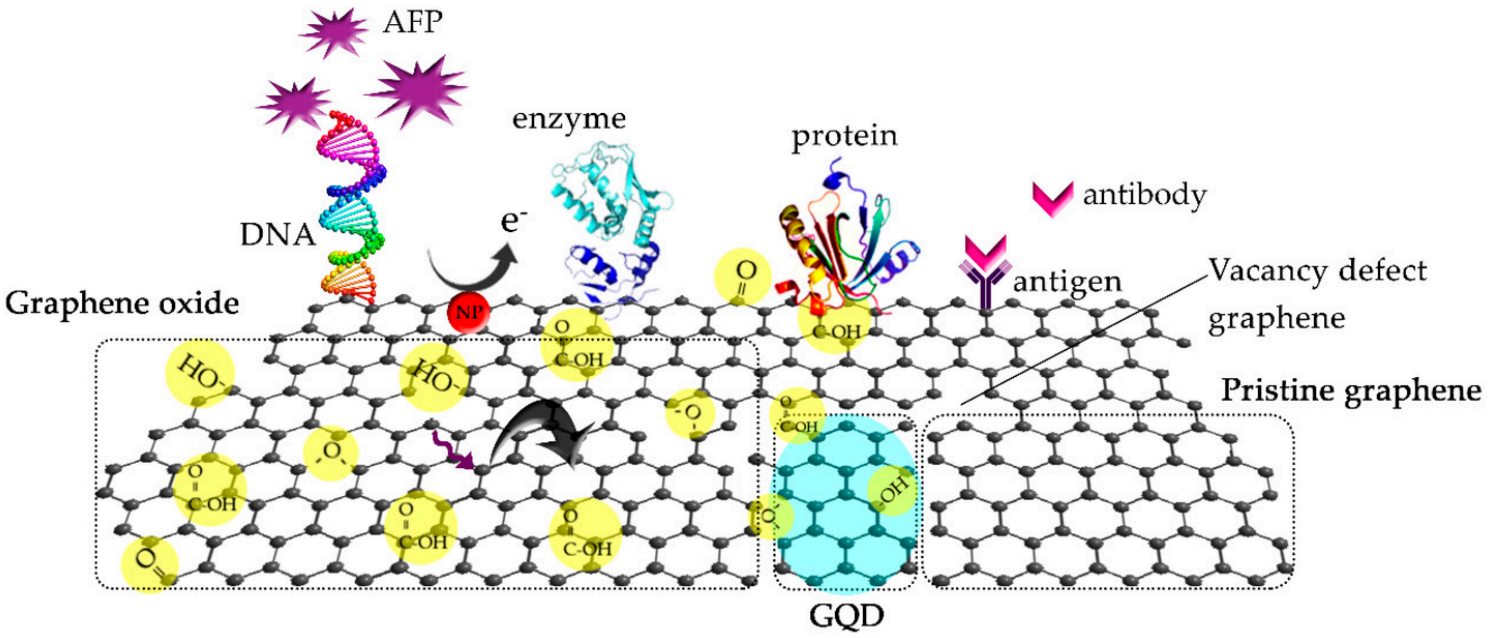
The synthesis of graphene-based materials in a presence of different methods can be controlled to confer properties for specific and desirable applications. Figure above shows the major types of graphene-based materials having been useful for engineering biosensors. The structure of pristine graphene is characterized as the array of 2D and sp_2 -hybridization of pure carbon atoms arranged in a hexagonal lattice with covalent bonds.

Meanwhile, functionalized graphenes are achieved by synthesis and preparation, for examples, the carbon core structure can be oxidized forming GO, the reduced structure with vacancy defects is RGO, structures a few nanometers in size with quantum phenomena are GQDs. Interestingly, many types of the GQDs have attracted interest due to their outstanding optical characteristics in the presence of photoluminescence involving specific binding capability to a wide range of biomolecules. Such morphological and intrinsic characteristics should serve the analytical transduction of biosensors on the limit of detection (LOD), sensitivity, selectivity, repeatability, and biocompatibility.

Graphene has several promising applications in bio usage, including:

1. Sensors: Used in various biomedical applications for monitoring health conditions.
2. Gene and Drug Delivery: Graphene can enhance the delivery of drugs and genes through its unique properties.
3. Tissue Engineering: It is utilized in developing tissue scaffolds to promote healing and regeneration.
4. Anticancer Therapies: Graphene-based materials are being explored for their potential in cancer treatment.
5. Antimicrobial Properties: Graphene can be used in implant applications to combat infections.

These applications highlight graphene's potential in advancing biomedical research and treatment.

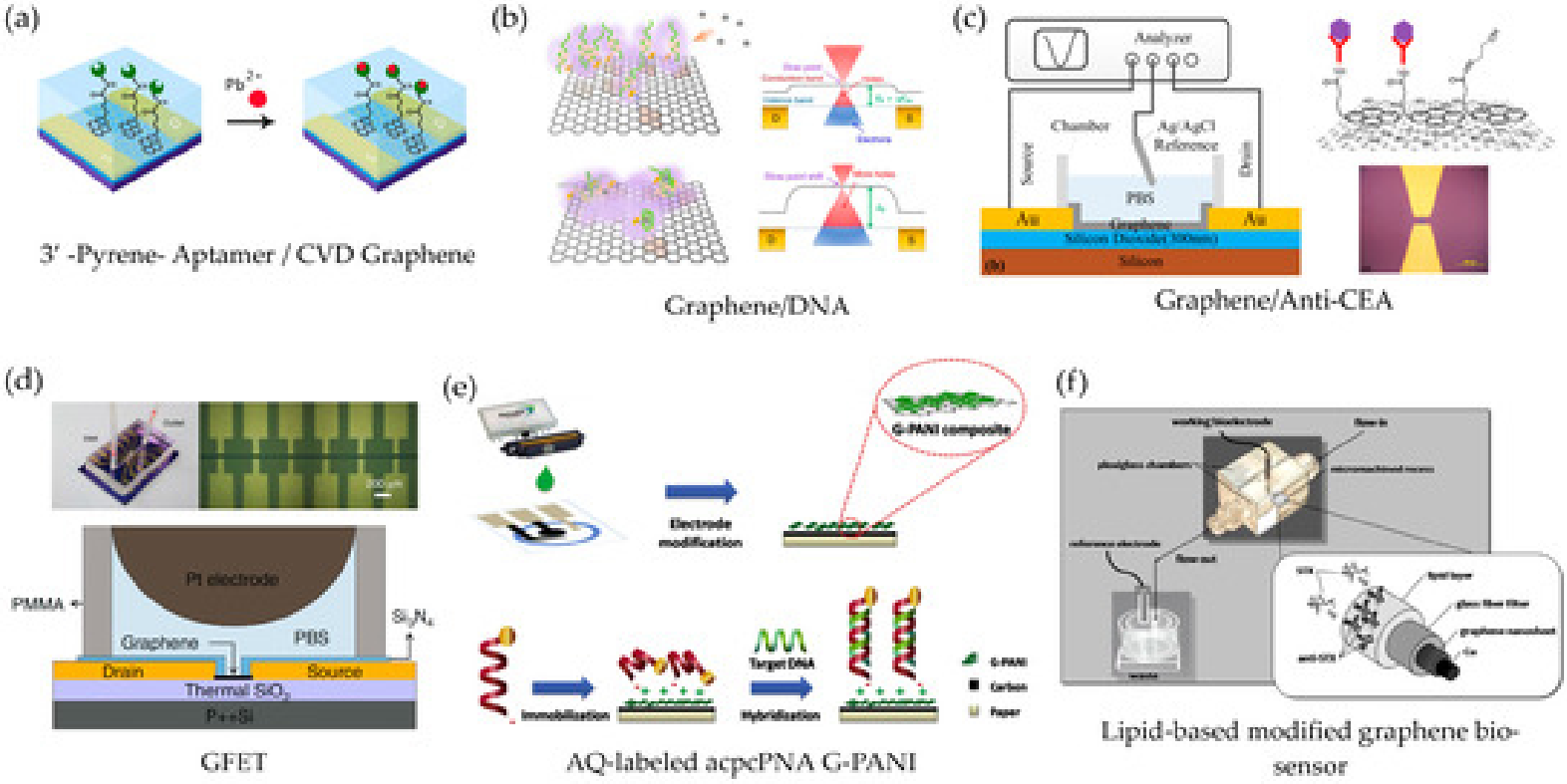


Graphene for Biosensing Applications

Previously, the structures and outstanding properties of graphene-based materials using different synthesis methods have been exploited in biosensing applications since graphene is a semi-metal with ultra-high charge mobility giving excellent electronic properties, having large surface area, being capable of being functionalized on its surface. There are many possible approaches to engineer the receptor for targeting biomolecules.

In the biomedical field, pristine graphene is not only referred to as an oxide-free graphene presenting π-π stacking, non-covalent interactions and high electrostatic force, but it also offers an infinite surface at a molecular level. Therefore, graphene provides for a high possibility of active sites for charge-biomolecular interactions due to the large specific surface area leading to a sensing enhancement as well as supporting the desired functionalization to target biomolecules to improve the selectivity.

Figure 6 illustrates the points of view of the possible interactions of the graphene-based material system. For example, the pure graphene area as shown in the figure can provide a charged area to absorb any charged molecules or metal ions as well as interactions at a vacancy defect. The functionalized graphene area is able to directly detect the biomolecules by its own oxide components due to the synthesis in which lots of epoxide, hydroxyl and carboxyl groups are formed on the edge and surface sites. In addition, the functionalized graphene allows binding of heteroatoms, nanoparticles (NPS), quantum dots (QDs), DNA, enzymes, proteins, antigens, antibodies, and other specific molecules

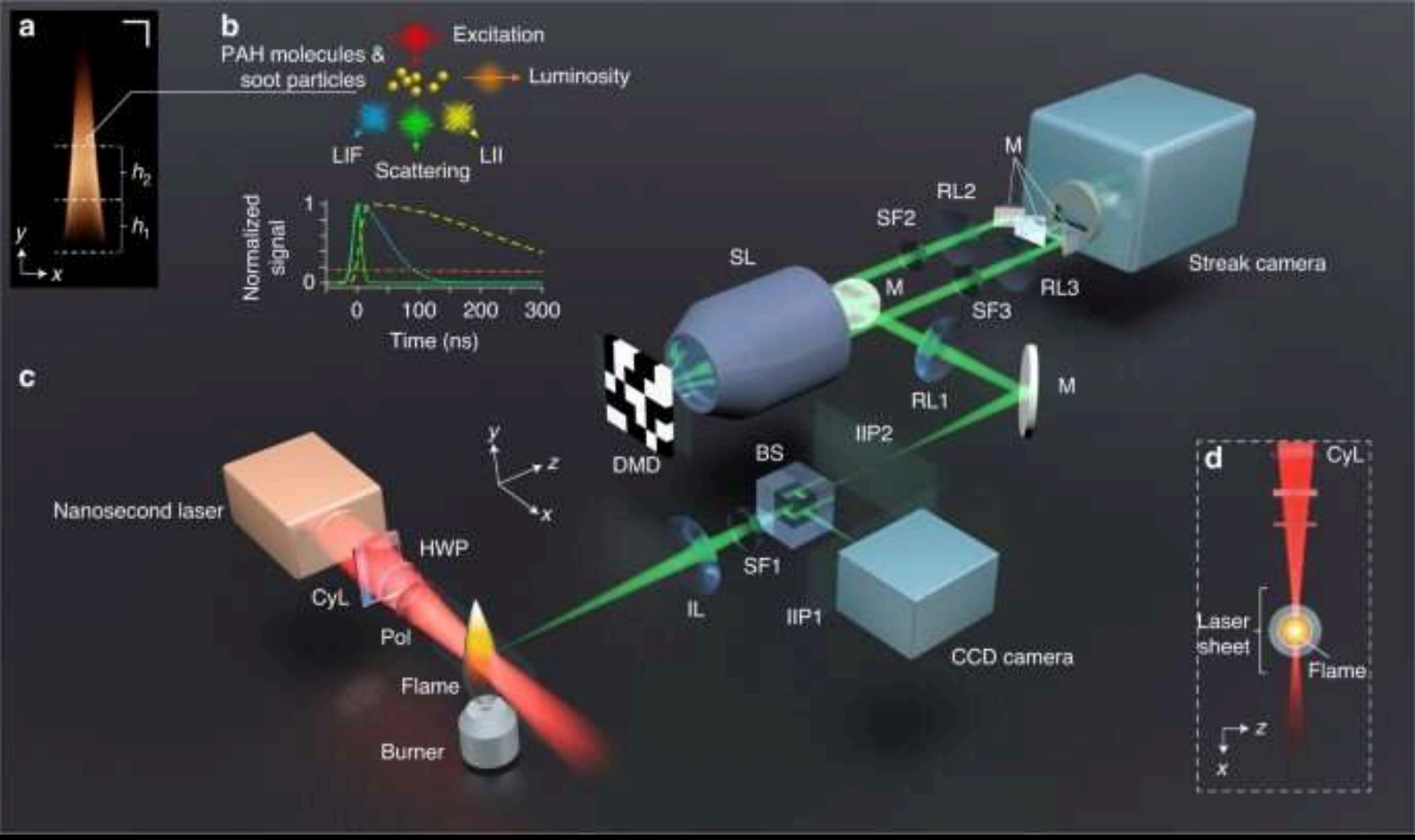


How Graphene-based Bio-Sensors Works

Schematic illustrations of graphene-based biosensors:
(a) Pb_{2+} in blood biosensor based on GFET;
(b) Pb_{2+} biosensor based on graphene/DNA;
(c) CEA protein biosensor based on graphene/anti-CEA;
(d) real-time binding kinetics and affinity of DNA hybridization based on GFET ;
(e) paper-based biosensor for human papillomavirus (HPV) detection; and
(f) a lipid-based modified graphene electrochemical biosensor

In the use of electrochemical properties of graphene material, a novel paper-based biosensor for human papillomavirus (HPV) detection was reported. The graphene-polyaniline (G-PANI) electrode is modified using an anthraquinone-labeled pyrrolidinyl peptide nucleic acid (acpcPNA) probe (AQ-PNA) and printed by inkjet printing method. In a presence of surface engineering of a negatively charged amino acid on graphene electrode through the electrostatic attraction, a synthetic 14-base oligonucleotide target with a sequence corresponding to human papillomavirus (HPV) type 16 DNA is measured the electrochemical signal response of the AQ label to identify the primary stages of cervical cancer.

On the development of electrochemical technology, graphene microelectrodes integrated with bilayer lipid membranes (BLMs) have shown promising results in both static and stirred experiments. Moreover, due to the support made of lipid film, the biosensor achieves a good reproducibility, reusability, high selectivity, rapid response times, long-shelf life, and high sensitivity. This enables a direct potentiometric measurement. Nikolelis et al. have also reported the use of the graphene microelectrodes in detecting toxicants, i.e., carbofuran in fruit, saxitoxin, cholera toxin and for diagnosis of d-dimers , urea and cholesterol as seen in figure above.

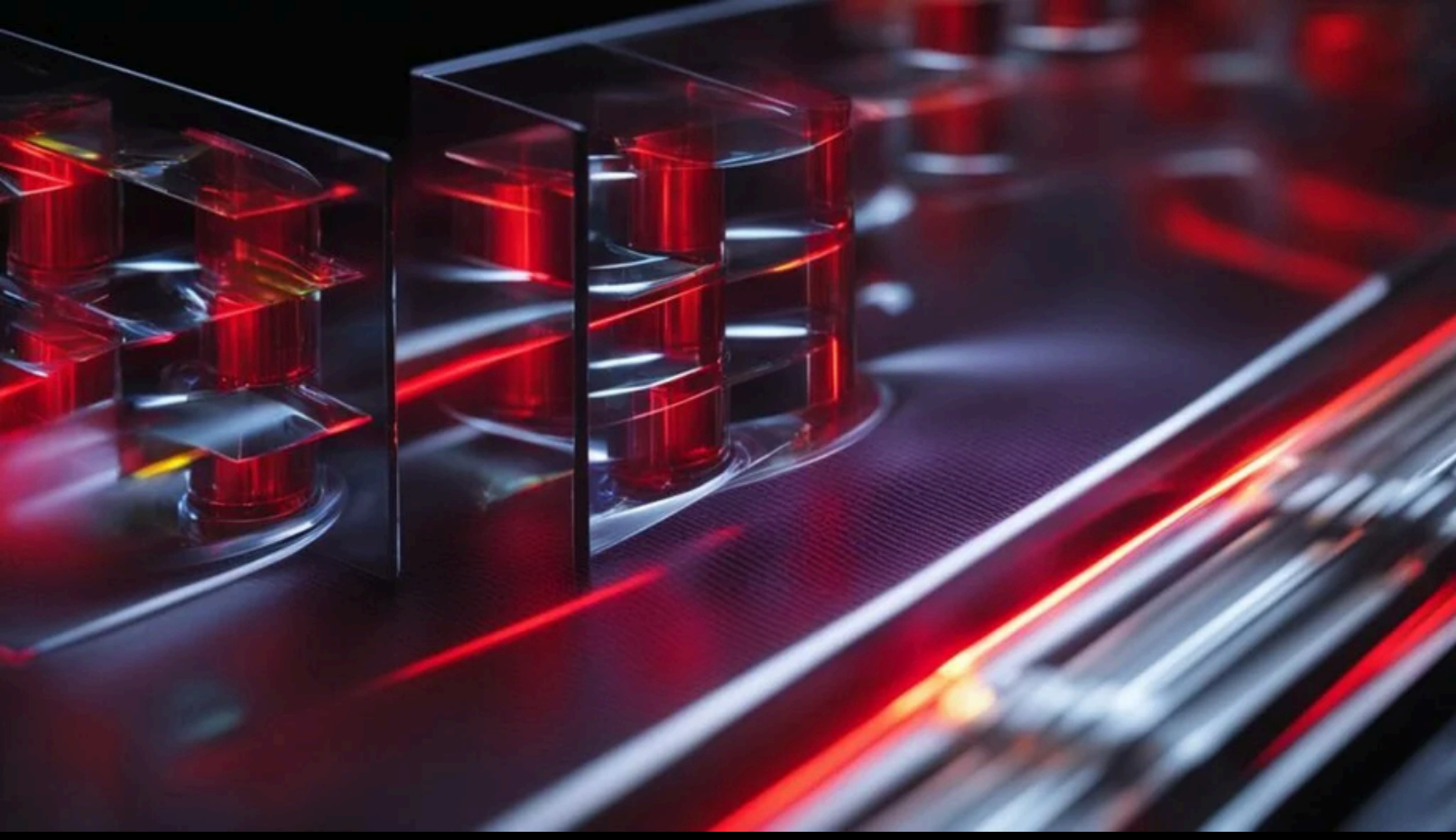


Laser : From Image Technology to Propulsion Power

Lubin and his team in UCSB's Experimental Cosmology Group will study photo-driven propulsion—the use of lasers as a means to power a spacecraft. The group has been awarded one of 15 proof-of-concept grants from NASA Innovative Advanced Concepts. The NASA program aims to turn what sounds like science fiction into science fact through the development of pioneering technologies.

"One of humanity's grand challenges is to explore other solar systems by sending probes—and eventually life," said Lubin. "We propose a system that will allow us to take the first step toward interstellar exploration using directed energy propulsion combined with miniature probes. Along with recent work on wafer-scale photonics, we can now envision combining these technologies to enable a realistic approach to sending probes far outside our solar system."

The UCSB group's ultimate goal is to send small probes to supplement the current long-range remote sensing done by orbital and ground-based telescopes. The funding will enable Lubin's team to create a more complete roadmap for building a fully functional wafer-scale spacecraft complete with power, laser communications and controllable photon thrusters. The project, Directed Energy Propulsion for Interstellar exploratioN (DEEP-IN), will also chart laser driver elements that require technology development.



Lunar Flashlight Propulsion System

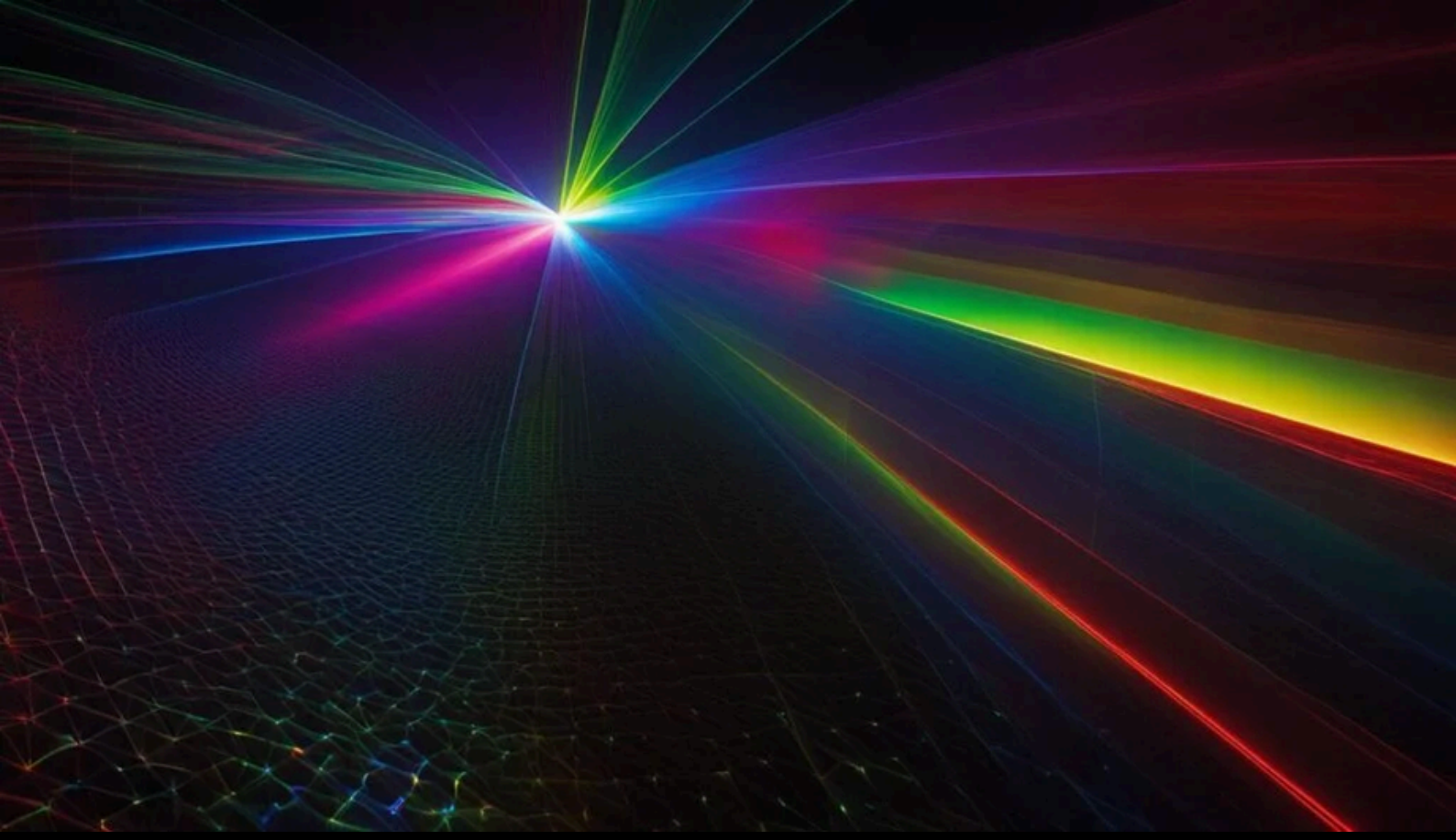
NASA's Lunar Flashlight mission successfully launched on Dec. 11, 2022, to begin its four-month journey to the moon, where the small satellite, or SmallSat, will test several new technologies with a goal of looking for hidden surface ice at the lunar South Pole. The mission is characterizing its new "green" propulsion system and developing a modified plan for the briefcase-size satellite's journey to the moon.

While the SmallSat is largely healthy and communicating with NASA's Deep Space Network, the mission operations team has discovered that three of its four thrusters are underperforming.

The mission team, which first observed the reduced thrust three days after launch, is working to analyze the issue and provide possible solutions. During its cruise, Lunar Flashlight's propulsion system has operated for short-duration pulses of up to a couple seconds at a time. Based on ground testing, the team thinks that the underperformance might be caused by obstructions in the fuel lines that may be limiting the propellant flow to the thrusters.

The team plans to soon operate the thrusters for much longer durations, hoping to clear out any potential thruster fuel line obstructions while carrying out trajectory correction maneuvers that will keep the SmallSat on course to reach its planned orbit around the moon. In case the propulsion system can't be restored to full performance, the mission team is drawing up alternative plans to accomplish those maneuvers using the propulsion system with its current reduced-thrust capability. Lunar Flashlight will need to perform daily trajectory correction maneuvers starting in early February to reach lunar orbit about four months from now.

Swooping low over the moon's surface, the briefcase-size SmallSat will use a new laser reflectometer built with four near-infrared lasers to shine a light into the permanently shadowed craters at the lunar South Pole to detect surface ice. To achieve this goal with the limited amount of propellent it's built to carry, Lunar Flashlight will employ an energy-efficient near-rectilinear halo orbit, taking it within 9 miles (15 kilometers) of the lunar South Pole and 43,000 miles (70,000 kilometers) away at its farthest point.



Ultrafast Nanoparticle - Laser Dynamics

Since the dawn of space exploration, NASA missions have primarily relied on radio frequency communications for this transfer of information. But at 2021, NASA's Laser Communications Relay Demonstration (LCRD) will launch and showcase laser communications—a revolutionary way of communicating data from space to the ground.

LCRD's ground stations, known as Optical Ground Station (OGS) -1 and -2, are located on Table Mountain, California, and Haleakalā, Hawaii. These remote, high-altitude locations were chosen for their clear weather conditions. While laser communications can provide increased data transfer rates, atmospheric disturbances—such as clouds and turbulence—can disrupt laser signals as they enter Earth's atmosphere.

"The way the local meteorology works, there is minimal dust and less atmospheric turbulence at the top of the mountain, which is great for laser communications," said Ron Miller from NASA's Goddard Space Flight Center and former development lead for OGS-2 in Hawaii. "It's about 10,000 feet up, so you're above a lot of the atmosphere and weather that occurs below the summit. It's very common to have a nice sunny day at the top and be cloudy around the midpoint of the mountain."

Advantages of Laser Communication in Space Missions	Description
High-speed data transmission	Laser beams transmit data at faster rates compared to RF communication, enabling efficient exchange of large amounts of information.
Secure communication	Laser signals are highly focused and less susceptible to interception or interference, ensuring the confidentiality and integrity of sensitive data.
Lightweight and energy-efficient	Laser communication systems are lightweight, reducing overall spacecraft weight and allowing for more payload capacity. They also consume less power, making them ideal for extended-duration missions.

Future of Laser Communications

The LCRD mission will communicate with two ground stations—on Table Mountain, California, and Haleakalā, Hawaii—to demonstrate optical communications between space and Earth. Credit: NASA's Goddard Space Flight Center

NASA communications engineers selected these sites because their weather patterns typically complement each other. When OGS-1 in California is cloudy, OGS-2 in Hawaii tends to be clear—and vice versa. To monitor cloud coverage and determine which station is to be used, commercial partner Northrop Grumman provided an atmospheric monitoring station that observes weather conditions at Haleakalā. This monitoring station runs nearly autonomously 24 hours a day, seven days a week. OGS-1 has similar weather monitoring capabilities at Table Mountain.

Despite the usually clear weather at these locations, NASA engineers must still work to reduce the effects of atmospheric turbulence on the data received by OGS-1 and OGS-2. To do this, both stations leverage the power of adaptive optics.

"An adaptive optics system uses a sensor to measure the distortion to the electromagnetic signal that's coming down from the spacecraft," said Tom Roberts, the manager of OGS-1 development and operations at NASA's Jet Propulsion Laboratory in Southern California. "If we can measure that distortion, then we can send it through a deformable mirror that changes its shape to take out those aberrations that the atmosphere induces. That allows us to have a nice, pristine signal."

While OGS-2 was developed specifically for the LCRD mission, OGS-1 is based at JPL's Optical Communications Telescope Laboratory, which prior to LCRD was used for previous laser communications demonstrations. To get OGS-1 ready for LCRD support, engineers had to upgrade the ground station, modifying the system to bring it up to a higher standard. One such upgrade involved replacing the mirrors to have better reflectivity and higher laser thresholds so that the telescope can receive and send laser signals to and from LCRD.

Prior to mission support, LCRD will spend about two years conducting tests and experiments. During this time, OGS-1 and OGS-2 will act as simulated users, sending data from one station to LCRD then down to the next. These tests will allow the aerospace community to learn from LCRD and further refine the technology for future implementation of laser communications systems.

Solar based Space Propulsion System

An innovative technique using light and tiny bubbles to propel microparticles at forces many times greater than previously achieved. The new technique could have significant implications in the development of micromotors and optical devices for use in solar cell optics. This technology aiming for highly accurate, passive technology for use in a concentrated solar device that would follow the sun without the need for a mechanical tracking mechanism.

According to the findings published recently in Nature Scientific Reports, the researchers converted the energy created from light into kinetic motion using nano-sized, laser-generated bubbles. As the bubble expands it acts as a propulsion mechanism for surrounding microparticles.

Dr. Niv says, "In our study, a micron-sized object was propelled at unprecedented speeds of close to one meter-per-second, six times faster than what is common in present devices, while still maintaining motion direction control." Dr. Niv and co-author Ido Frenkel, a Ph.D. student, are part of BGU's Alexandre Yersin Department of Solar Energy and Environmental Physics at the Jacob Blaustein Institutes for Desert Research.

"After the bubble initiates movement and bursts, there is no trace of the vapor; the system returns to the original state and the same action can be initiated repeatedly, like a combustion engine."

Visit Us at Dreamarks Magazine

NEVER MISS AN ISSUE!

VISIT US AT DREAMARKS.COM

WWW.DREAMARKS.COM

Catch the freshest features
Updated daily
Read anytime, anywhere