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VENUE- **PAILAN COLLEGE OF MANAGEMENT AND TECHNOLOGY**

TOPIC-**PLASMONICS**

SPEAKER-**PROFESSOR Dr. YOSHIAKI NISHIJIMA(YOKOHAMA NATIONAL UNIVERSITY)**

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Electronics is rapidly developing and its applications are becoming a necessity for the modern world. One key element for this expeditious growth is the continuous research in the field of plasmonics by capable professors like Prof. Dr. Yoshiaki Nishijima of Yokohama National University.

On 01.02.2016, Pailan College of Management and Technology had conducted a seminar for the engineering students, especially the electronics students to develop a basic idea and provide information about plasmonics. The seminar was initiated by a short speech on the world of electronics by our respected principal sir. Then , Prof. Dr. Yoshiaki Nishijima was greeted with a bouquet of flowers. We were eternally grateful to have Dr. Yoshiaki Nishijima as our chief speaker as he has a vast knowledge on electronics, especially plasmonics.

The students as well as the faculty members who had attended the seminar have developed a keen concept about plasmonics, one of the most important cornerstones of future photonic technologies . The aim of the seminar is to provide knowledge and basic understanding of the fundamental and applied aspects of controlling, guiding and manipulating electromagnetic radiation on the sub-wavelength.

Prof. Nishijima first started by introducing himself. He described the increasing number of Indian students trying to bag education from Japan.

The manifold stuffs that the attendees have come across are:-

- Plasmonics is the study of the interaction between electromagnetic field and free electrons in a metal. The whole notion of plasmonics is surrounded by the idea of plasmons.
- Plasmon is the quantization of the collective longitudinal excitation of a conductive electron gas in a metal. can be considered as a quasi-particles since it arises from the quantization of plasma oscillations, just like photons are quantization of mechanical vibrations.
- Plasmons play a large role in the optical properties of metals and semiconductors. The optical properties of a metal is described by dielectric function and it solely depends upon the freely moving conduction electrons of the metal.
- A surface plasmon polariton (SPP) is a coupled charge-density electromagnetic wave that is bound to the interface between a material with a negative dielectric constant (for instance, silver or gold) and a material with a positive dielectric constant (for instance, air or glass). The SPP's have attracted significant interest because it opens new ways to manipulate light on nanometer scales. Considerable efforts have been made towards integrated optical devices and circuits and future all-optical photonic chips.
- The plasmon energy can often be estimated in the free electron model as,

$$E = \left(\frac{h}{2\pi}\right) * \sqrt{ne^2/\mathrm{m}\,\varepsilon_0}$$ where n is

the conduction electron density, e is the elementary charge, m is the electron mass, ε_0 is

the permittivity of free space, h is the Planck constant.

- In the earliest 1900, the famous scientist Drude constructed his theory of electrical and thermal conduction by applying the kinetic theory of gasses to a metal, considered as a gas of electrons. In its simplest form the Kinetic theory treats the molecules of a gas as identical solid spheres, which move in straight lines until they collide with one another. Although there is only one type of particle in the simplest gases, in metal there must be at least two. The electrons must be compensated by positive carriers to leave the metal electrically neutral. Drude assumed that the compensating positive charge was attached to much heavier particles, which he considers to be immobile. At this time was not much knowledge of light and mobile electrons and immobile positive charges.
- We should simply assume that when atoms of a metallic elements are brought together to form a metal, the valence electrons become detached and wander freely through the metal, while the metallic ions remain intact and play the role of the immobile positive particles in the Drude theory

- Drude Model can be given by-

$$\in(\omega) = \in b(\omega) - \frac{\omega_p^2}{\omega^2 + i\omega/\tau}$$

where $\in(\omega)$: permittivity of metal, $\in b(\omega)$: Background permittivity (due to bound electrons), ωP : Plasma Frequency, τ : Mean Relaxation time

- The two most significant results of the Drude model are an electronic equation of motion,

$$\frac{d}{dt}p(t) = q\left\{E + \frac{p(t) * B}{m}\right\} - \frac{p(t)}{\tau}$$

and a linear relationship between current density **J** and electric field **E**,

$$J = \left(\frac{nq^2\tau}{m}\right)E$$

Here *t* is the time and *p*, *q*, *n*, *m*, and τ are respectively an electron's momentum, charge, number density, mass, and mean free time between ionic collisions (that is, the mean time an electron has traveled since the last collision, not the average time between collisions). The latter expression is particularly important because it explains in semi-quantitative terms why Ohm's law, one of the most ubiquitous relationships in all of electromagnetism, should be true.

Plasmonics has already furnished several applications and has still the potential to show many more.

- One of the most common applications of plasmonics is the guiding and manipulating of light which is possible due to the confinement in sub-wavelength regime and coupling ability.
- As Plasmon has the property of enhanced absorption, it can be used for controlled drug delivery, micro fluidic mixing, and even cancer therapy.
- The "near field enhancement" attribute contributes its effects in the field of laser antennas and fibers.
- It is often used as the contrasting agent for imaging due to its ability of enhanced scattering.

After Dr. Yoshiaki Nishijima had shown his last slide, the students of electronics branch interacted with different aspects and fraternized with Dr. Yoshiaki Nishijima. After giving satisfactory answers, he concluded the seminar.

The students were proud to have him as the main speaker. They have learnt a lot of things and were appreciative to have been exposed to such an environment. Many are desiring to research and explore in plasmonics. They have fully savvied the subject and hence, the eminence of the seminar is remarkable.

After the Seminar terminated, various students had executed cultural events. Some had displayed their dancing skill on a traditional song of Rabindranath Tagore while many had sung songs. A few students even recited some poems of our beloved Rabindranath Tagore making the seminar even more interesting in every countenance. Our respected Principal Sir presented him with a memento in remembrance of wonderful success of this seminar.

From extreme left corner: Mr. Debraj Chakraborty (R & D Coordinator, PCMT), Prof.(Dr.) Kisalaya Chakrabarti (Principal-B.Tech. Division, PCMT), Prof. (Dr.) Yoshiaki Nishijima , Mr. Sushovan Biswas (Assistant Professor, ECE Deptt.)

Dr. Y. Nishijima --- during his presentation in the seminar