

## **RAMAN SPECTROSCOPY**

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On March 25, 2025, from 1:50 PM to 4:30 PM, MVJ College of Engineering (MVJCE) hosted a session on Raman Spectroscopy in Seminar Hall 1. Dr. Vengatesh from Sathyabama Institute of Science and Technology, Chennai, delivered the lecture.

MVJ College of Engineering (MVJCE) organised a three-day Faculty Development Program (FDP) focusing on Materials Characterisation and Techniques. As a crucial aspect of material analysis, Raman Spectroscopy was featured on the first day of the program. Dr. Vengatesh from Sathyabama Institute of Science and Technology was invited to deliver an insightful lecture on the principles, applications, and advancements in Raman Spectroscopy. The session aimed at equipping faculty members with a comprehensive understanding of this powerful analytical technique, enabling them to integrate it effectively into their research and teaching methodologies.

The session commenced with a welcome address by Dr. Daniel T, who introduced the speaker and highlighted the significance of Raman Spectroscopy in modern materials science. Following the welcome, Dr. Preethi, Head of the Chemistry Department, felicitated Dr. Vengatesh with a bouquet as a gesture of appreciation.

Dr. Vengatesh initiated his lecture by providing a foundational overview of Raman Spectroscopy, emphasising its non-destructive nature and its ability to provide detailed information about molecules' vibrational, rotational, and other low-frequency modes. He elucidated the basic principles of Raman scattering, differentiating it from Rayleigh scattering and explaining the concept of Stokes and anti-Stokes shifts.

Much of the lecture explained the various types of molecular vibrations. Dr. Vengatesh illustrated these concepts using clear diagrams and examples, making complex theoretical concepts accessible to the audience. He elaborated on the relationship between molecular vibrations and the resulting Raman spectra, highlighting how the spectral features can be used to identify and characterise materials.

### **Key Concepts and Applications:**

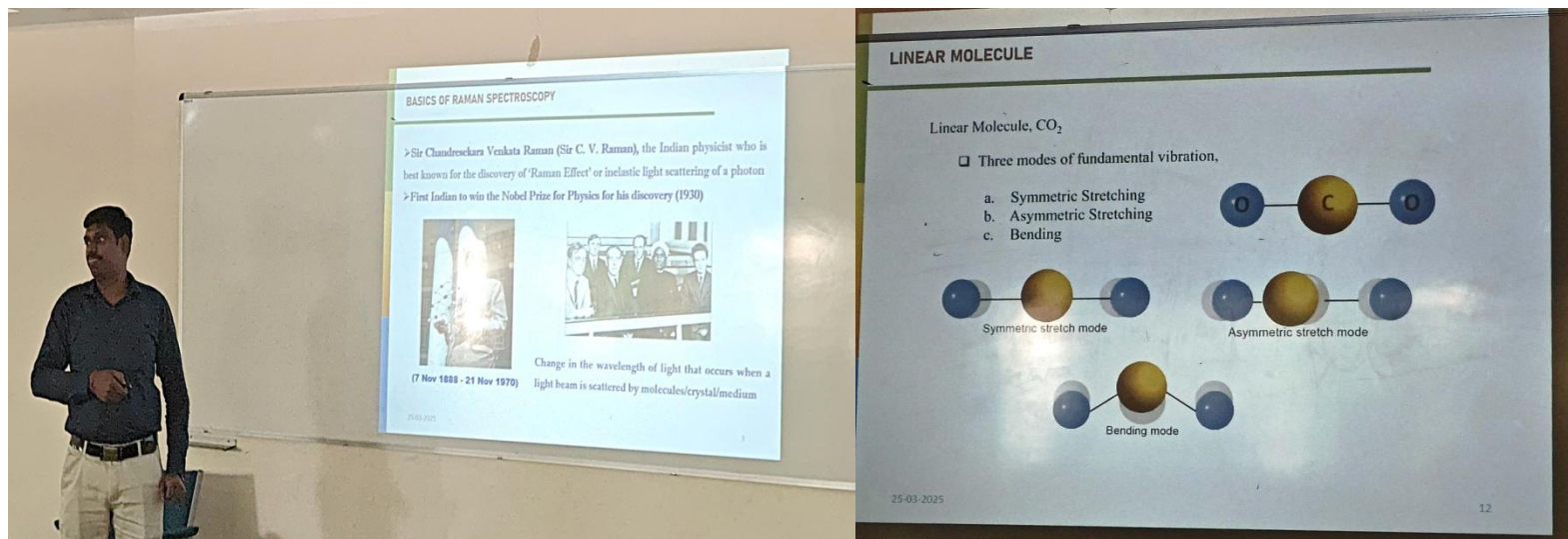
Dr. Vengatesh delved into the instrumentation aspects of Raman Spectroscopy, discussing the components of a typical Raman spectrometer, including lasers,

monochromators, and detectors. He explained the importance of laser selection and the impact of laser wavelength on the quality of the Raman spectra.

The lecture covered a wide range of applications of Raman Spectroscopy in various fields, including:

- **Materials Science:** Characterisation of nanomaterials, polymers, semiconductors, and composites.
- **Chemistry:** Identification of chemical species, monitoring chemical reactions, and studying molecular structures.
- **Biology and Medicine:** Diagnosis of diseases, analysis of biological tissues, and drug development.
- **Geology and Mineralogy:** Identification of minerals and studying geological samples.
- **Forensic Science:** Analysis of trace evidence and identification of unknown substances.





**Image: Dr. Vengatesh is explaining about RAMAN SPECTROSCOPY**

Dr. Vengatesh emphasised the advantages of Raman Spectroscopy over other analytical techniques, such as infrared spectroscopy, highlighting its ability to analyse samples in aqueous solutions and its suitability for studying samples with complex matrices. He also discussed the limitations of Raman Spectroscopy, such as fluorescence interference and the need for careful sample preparation.

#### **Advanced Techniques and Insights:**

The lecture extended beyond the fundamental principles to cover advanced Raman techniques, including:

- **Surface-Enhanced Raman Scattering (SERS):** Dr. Vengatesh explained how SERS enhances the Raman signal by using metal nanoparticles, enabling the detection of trace amounts of analytes.
- **Tip-Enhanced Raman Spectroscopy (TERS):** He discussed using TERS to achieve nanoscale spatial resolution, allowing the study of individual molecules and nanostructures.
- **Resonance Raman Spectroscopy:** He explained how resonance Raman spectroscopy enhances the Raman signal when the laser excitation wavelength matches an electronic transition of the analyte.
- **Confocal Raman Microscopy:** He explained using confocal microscopy to get spatially resolved Raman spectra.

Dr. Vengatesh provided numerous examples of real-world applications, showcasing the versatility and power of Raman Spectroscopy. He shared case studies from his research, demonstrating the practical implications of the technique.

#### **Interactive Session and Q&A:**

The lecture was highly interactive, with Dr. Vengatesh encouraging questions and engaging in discussions with the participants. He addressed the faculty members' queries regarding sample preparation, data interpretation, and the selection of appropriate experimental parameters. The audience showed keen interest in the practical aspects of

Raman Spectroscopy, particularly its application in their respective research areas. Dr. Vengatesh provided valuable insights and helpful tips, drawing from his extensive experience in the field.

**Conclusion:**

The session on Raman Spectroscopy delivered by Dr. Vengatesh was highly informative and engaging. He presented the complex concepts of Raman Spectroscopy clearly and concisely, making them accessible to faculty members from diverse backgrounds. The lecture provided a comprehensive overview of the principles, applications, and advancements in Raman Spectroscopy, equipping the participants with the knowledge and skills to utilise this powerful analytical technique effectively.

The session was a valuable addition to the three-day FDP on Materials Characterisation and Techniques, contributing significantly to the professional development of the faculty members at MVJCE. The insights gained from the lecture will undoubtedly enhance their research capabilities and enrich their teaching methodologies. The FDP was well organised and allowed for a great deal of learning. The participants expressed their appreciation for Dr. Vengatesh's expertise and the clarity of his presentation.