亮点报道：葡萄糖分子的针尖增强拉曼散射

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研究者们提出表面改性或功能化的方法将葡萄糖分子吸附在裸金属表面，以增强分子的拉曼散射特性。然而，SERS 的静态等离子体腔特性，使其只能随机检测葡萄糖分子的部分拉曼模式，且会受到桥联剂分子拉曼特征峰干扰。因此，如何准确获取葡萄糖分子的“指纹信息”依然是一个挑战。

西北工业大学物理科学与技术学院张文定教授、梅霆教授团队将光纤结构光场调控研究工作与扫描近场光学显微 (SNOM) 相结合，自搭建了针尖增强拉曼光谱术 (TERS) 平台。该等离激元光纤探针基 SNOM-TERS 平台，可高效实现无背景针尖纳腔聚焦光源产生，且可将针尖纳米聚焦光源的电场强度提高 2 个数量级。得益于 SNOM 的剪切力反馈控制技术，其可精准调控针尖纳米聚焦光源与葡萄糖分子的空间位置关系，进而显著提高了葡萄糖分子的拉曼散射效率。利用该 SNOM-TERS 平台，在 400~3200 cm-1 窗口内实现了葡萄糖分子拉曼振动模式的全谱激发，且利用观测到的 C=O 键伸缩振动，确认其为链状葡萄糖分子。

该光纤探针基 SNOM-TERS 平台为准确识别分子的拉曼散射提供了强大的工具，有助于生物分子物构解析技术的发展。

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Highlights: Tip-enhanced Raman scattering of glucose molecules

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Surface modification or functionalization methods have been proposed to enhance the adsorption of glucose molecules on bare metal, thereby improving their Raman scattering intensity. Nevertheless, due to the static plasmon cavity characteristic of SERS, it can only randomly detect partial Raman modes of glucose molecules and may be interfered by Raman peaks of bridging agent molecules. Therefore, accurately obtaining the "fingerprint information" of glucose molecules remains a formidable challenge.

The team of Prof. Wending Zhang and Ting Mei from the School of Physical Science and Technology at Northwestern Polytechnical University integrated fiber vector light field with scanning near-field optical microscopy (SNOM) to develop a tip-enhanced Raman spectroscopy (TERS) platform. This fiber tip-based SNOM-TERS platform efficiently generates a background-free tip nanofocusing light source, enhancing the electric field intensity of the tip nanofocusing light source by two orders of magnitude. The SNOM-TERS platform enabled full-spectrum excitation of the Raman vibration modes of glucose molecules within the spectral window of 400-3200 cm^{-1}, confirming the presence of chain glucose molecules through the observed C=O stretching vibration.

The fiber tip-based SNOM-TERS platform offers a robust tool for accurately identifying molecular Raman scattering and contributes to the advancement of biomolecular structure analysis techniques.

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