DREXEL UNIVERSITY
Materials Science and Engineering
College of Engineering

Department of Materials Science and Engineering,

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Two-dimensional MXenes as novel surface-enhanced Raman spectroscopy substrates

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Abstract
Since its discovery over 90 years ago, Raman spectroscopy has become an essential characterization tool in materials science. The inelastic vibrational spectroscopy can reveal the structure and composition of a material, giving analyzed samples a unique vibrational "fingerprint". Several of the challenges of Raman spectroscopy, including low sensitivity and strong fluorescence signals, have been addressed with enhancement techniques. Namely, surface-enhanced Raman spectroscopy (SERS) is performed by placing analyte molecules near metallic nanostructures, significantly improving the signal while maintaining the benefits of non-destructive analysis, fast acquisition times and easy substrate preparation. SERS substrates are commonly made with noble metals, such as silver and gold nanostructures, making scalability expensive and reproducibility challenging. There have been ongoing efforts to study SERS substrates made from earth-abundant materials, more commonly 2D structures. Among those, MXenes (2D transition metal carbides, nitrides and carbonitrides) stand out due to their plasmonic properties, as well as rich surface chemistries, enabling both mechanisms of SERS. The goal of this presentation is to cover the basics of Raman spectroscopy and the fundamentals of SERS, as well as to provide an evaluation of novel MXene substrates from literature reports.