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Mechanism of Surface-Enhanced Raman Scattering on Multilayer $Ti_3C_2T_X$ Nanosheets[1] TEJ LIMBU, Department of Physical and Applied Sciences, University of Houston-Clear Lake, Houston, TX, 77598, BASANT CHITARA, MARTHA GARCIA CERVANTES, Department of Chemistry and Biochemistry, North Carolina Central University, Durham, NC 27707, USA, YU ZHOU, SHENGXI HUANG, Department of Electrical Engineering, The Pennsylvania State University, University Park, PA 16802, USA, YONGAN TANG, FEI YAN, Department of Chemistry and Biochemistry, North Carolina Central University, Durham, NC 27707, USA, PSU COLLABORATION, NCCU, UHCL TEAM — MXenes have attracted great attention as flat substrates for surface-enhanced Raman scattering (SERS) applications. However, the underlying SERS mechanism has not been a focus of any investigation. Herein, we report the first systematic experimental study on the SERS activity of $Ti_3C_2T_X$ nanosheets with thickness ranging from 5 to 120 nm, using methylene blue (MB) as a probe molecule. We found that SERS intensity increases with the MXene nanosheet thickness. The thickness-dependence of the Raman enhancement can be accounted for by the adsorption and intercalation of MB molecules into the interlayer spacing of $Ti_3C_2T_X$. Furthermore, by combining experimental observations and numerical calculation, we confirm that the charge transfer mechanism is dominantly responsible for Raman enhancement on $Ti_3C_2T_X$. Additionally, we report an observation of resonance coupling of charge transfer and molecular transition as a contributing factor to the higher EF obtained with a 633 nm laser excitation. Taken together, these findings have significant implications for cost and performance optimization in designing MXene-based SERS substrates for next-generation chemical and biological sensing platforms.

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