

EM

Recent Advances in SERS for Sensing Devices

We present a brief review of the theory of SERS in both metals and semiconductor substrates.

We begin with recent experiments exploring semiconductor substrates. We examine recent results on various doped GaN surfaces, and some further results on the enhancement of phonon modes in TiO₂ and other systems. On GaN nanorods we find that for low doping we can obtain the degree of charge-transfer, and follow it as the doping is increased, filling the conduction band. We then turn to TiO₂ substrates. We examine how the degree of charge-transfer can be utilized to determine the location and oscillator strength of the main contributors to the SERS enhancement.

We further examine several forensic applications of SERS, including the examination of opioids such as fentanyl, and mixtures of these compounds with heroin and cocaine as found in crime scenes. We also examine SERS detection of "zombie" drugs, which are synthetic cannabinods. These are vastly more powerful than THC, and very dangerous. In all these cases the optimum SERS signal was obtained by selecting the excitation wavelength to coincide with a charge-transfer transition in the molecule-metal system.

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