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Enhanced Raman Spectra of Black Dye N719 on GaN Nanowires*Cyril Muehlethaler^a, Asami Odate^b, Jan L. Weyher^c, Igor Dziecielewski^c, John R. Lombardi^d*^a University of Quebec at Trois-Rivieres, Canada, Department of Chemistry, Biochemistry and Physics^b Brown University, Providence, USA, Department of Chemistry^c Institute of High Pressure Physics, Poland, Polish Academy of Sciences^d City College of New York, USA, Department of Chemistry and PhD program in Chemistry, CUNYCorresponding author:

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Gallium Nitride (GaN) substrates have recently been proposed as high performance substrates for surface enhanced Raman (SERS) measurements. The GaN substrate acted as a template for nano-structuration of the surface, and a noble metal (e.g. silver or gold) supported the electrical fields and surface plasmon resonances deemed necessary for SERS. However, we demonstrate here that charge transfer conditions can be approached with a selected molecule on pure GaN substrates, and that the surface plasmon resonances of the noble metals are not a prerequisite anymore to obtain SERS conditions. We use a black dye (N719) adsorbed on GaN bundles of nano-wires for which the charge transfer resonances can contribute enhancement factors up to 10^4 . The charge transfer (CT) transition from the GaN substrate valence band (-6.75 eV) to the molecular LUMO (-4.26 eV) is in resonance with the energy of the laser excitation at 488 nm (2.54 eV), and with the molecular resonance within the N719 molecule ($\omega_{\text{Mol}} = 2.47$ eV).

Keywords: SERS, charge transfer, plasmon, resonance, enhancement factor

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