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Technology of nano-structuring of GaN for surface enhanced Raman spectroscopy measurements

It is commonly accepted that the presence of so-called hot-spots is necessary for obtaining high enhancement factor (EF) of Raman signal from individual molecules attached to the plasmonic metal particles. It was experimentally confirmed that organic (biological, chemical) molecules located at hot-spots contribute most significantly to the overall surface enhanced Raman spectroscopy measurements (SERS) intensity. Two approaches are usually used in order to deliver SERS platforms, namely planar and nano-structured substrates, both with plasmonic metal particles on the top surface. It has been shown experimentally that 3D SERS substrates are more efficient for SERS measurements compared with planar substrates. The aim of this presentation is to demonstrate the technology of nano-structuring of hetero-epitaxial GaN substrates using different (photo)-etching methods as well as tailoring of plasmonic metal surfaces for increased SERS efficiency. Highly rough and stable GaN surface are formed by defect-selective photo-etching of GaN layers containing dislocations. The resultant nano-

pillars contribute to the formation of hot-spots and high EF. It will be shown that orthodox etching yielding well developed pits also leads to the formation of hot-spots and EF up to $10E6$ for the examined test molecules of para-mercaptobenzoic acid (pMBA). The efficiency of SERS platforms can also be tailored by chemical treatment (dealloying) of sputtered alloyed metal layer of Au-Ag and Au-Cu and by thermal treatment leading to recrystallization of metal clusters. The novel SERS platforms based on etched GaN show very good mechanical and chemical stability and high EF up to $10E7$. This feature enabled time-lapse measurements of various biological systems such as Hepatitis B virus antigen and DNA and recently of different bacteria (BC, BT, and BS).

Biography

J L Weyher has completed his PhD at Military Academy of Technology in Warsaw, Poland and received Habilitation at University of Montpellier in France in 1995. He is an Associate Professor at Institute of High Pressure Physics in Warsaw. He has published more than 200 papers in reputed journals.

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