Electrochemical Surface-enhanced Raman Scattering Microfluidic Chip Fabricated by Hybrid Femtosecond and CW Laser Processing

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Hybrid femtosecond (fs) laser and continuous wave (CW) laser processing offers distinct features for advanced manufacturing of functional nanodevices. In this presentation, we apply this hybrid technique to fabricate electrochemical surface-enhanced Raman scattering (CE-SERS) microfluidic chip. The non-contacting feature of laser processing allows us to create all components of EC-SERS in a glass microfluidic by successive laser processing using different lasers as shown in figure 1 (ship-in-a-bottle fabrication technique). Briefly, we use 1030 nm fs laser and 405 nm CW laser to fabricate a three-electrode system in the glass microfluidic chip for EC-SERS analysis. The procedure includes: (1) Preparation of the three-dimensional glass microfluidic chip by fs laser assisted chemical etching method; (2) Formation of the working and contour electrodes by fs laser direct write ablation and successive selective metallization of Au; (3) Synthesis of ZnO nanowires on the working electrode by CW laser induced hydrothermal growth, followed by decorating the ZnO nanowires with Ag nanoparticles by CW laser reduction of metal ions; (4) Formation Ag reference electrode by fs laser induced nanojoining of Ag nanoparticles on a part of Au film. Consequently, the fabricated EC-SERS chip is successfully applied for the analysis of molecular spectrum of vitamin.

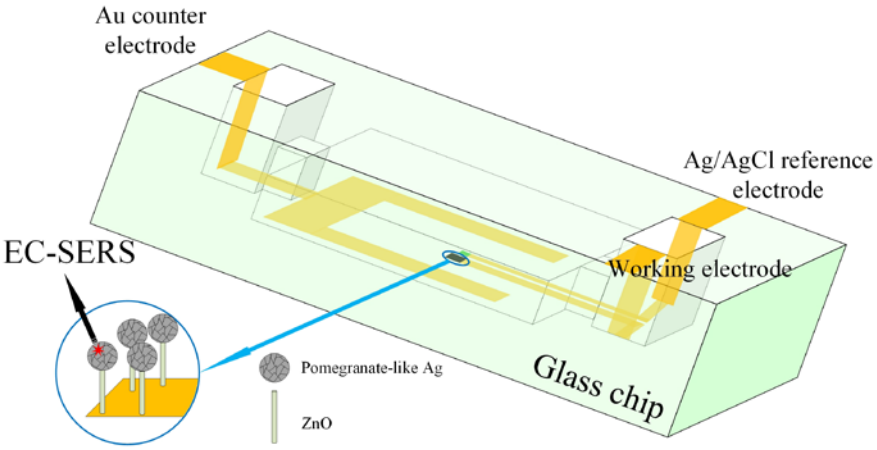

Figure 1. Schematic of configuration of EC-SERS microfluidic chip fabricated by hybrid femtosecond and CW laser processing.